On the Existence of Digital Objects

Yuk Hui

Foreword by Bernard Stiegler

ON THE EXISTENCE OF DIGITAL OBJECTS

ELECTRONIC MEDIATIONS

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Foreword

Bernard Stiegler

Translated by Daniel Ross

This book by Yuk Hui is an exceptional work in many ways, foremost thanks to the scope of the author's questions and the resources he manages to incorporate into his thinking, which he does with unusual rigor and an invaluable openness of mind and spirit. *Ouverture d'esprit* should in this case be taken literally: Yuk Hui practices this openness that is the life of the mind, and he does so methodically, via notions of relations of scale and orders of magnitude. He convokes analytical and continental philosophy, cognitivism and phenomenology, and computational theory alongside the human and social sciences, showing that the relations and nonrelations between them are to a large extent the result of unconceptualized questions of scale. His is a most generous form of thinking: situating philosophies and theorems on scales that relate them in terms of order of magnitude allows room for hospitality toward all manner of rigorous and original thinking.

One might be tempted to see in such a project of rationally ordering the archipelago of contemporary knowledge an outdated desire for systematicity. One would be wrong. The system may indeed be a question for Yuk Hui, but his thinking of orders of magnitude, ordered in terms of their relations, goes far beyond this: it becomes instead a question of milieux. The sciences and technologies of automation and automatism—in their movement from Ludwig von Bertalanffy to big data and passing through cybernetics, information theory, and open systems theory, and by reactivating and transforming the questions of thermodynamics and biology—do indeed, in the broadest sense, lead back to and renew systemic questions. And to the extent that such systems form the production apparatus of globalized capitalism, they do lead to an expansion of the questions opened by Marx in the *Grundrisse,* in his "Fragment on Machines." Hence it is also from within this economico-political horizon that we must read the present work.

But with the concept of the *digital object,* Yuk Hui shows that, in the dynamic systems that continuously reconfigure the artifacts emerging from industrial innovation, new relativities of scale form and deform, and from this arise improbabilities that are always in dynamic excess over and above the systems whence they derive. In this context, the system must be understood not just as a system but above all as a preindividual milieu. From out of the preindividual, there forms what Gilbert Simondon called an associated milieu (a term with more than one meaning). Hence Yuk Hui passes through Simondon. But he also revisits Heidegger and stages a reciprocal confrontation between them—and we should not forget that Heidegger was himself a reader of Jakob von Uexküll, for whom the question of milieu became that of the *Umwelt,* which then contributed to the formation of the concept of world in the existential analytic of *Sein und Zeit.*

Understanding contemporary automated systems on the basis of the concept of the digital object, then, means redefining them in a way that passes through the concepts of preindividual milieu, individuation, world, being-in-the-world, *Zuhandenheit* and its associated milieu—which may in addition provide new resources with which to interpret the notions of *Gestell* and *Ereignis,* through which Heidegger explored the cybernetic age. In this light, the analysis of the system that Heidegger conducts in his course on Schelling perhaps merits reinterpretation.[1] The twentieth century would then have been that of systems theory in a sense entirely different from what the philosophies of modernity have generated out of the "system of idealism" that crystallized around Kant. If, as Heidegger argued, the concept of system is for Schelling inseparable from the question of the freedom of spirit (and of spirit as openness), then conversely, the question of the system, which arises in a new way in the *Gestell* of the cybernetic age, must be redefined with Simondon in terms of a realism of relations and an analysis of processes of individuation that are woven as relations of scale and orders of magnitude: such are the conjectures with which *On the Existence of Digital Objects* may inspire us.

The *industrial* milieu—which is here the stake—first began to emerge during that epoch that saw the young Hegel, Hölderlin, and Schelling all debating Kantian idealism. The scientific concepts that arose at that time (including those of thermodynamics) then become central to the various systems theories formulated in the course of the twentieth century. Yet this still completely escaped these three precocious thinkers of the end of the nineteenth century, and this is so in particular because these scientific concepts (forming the "new rationality" that we find ourselves groping for in the "new alliance" that Ilya Prigogine and Isabelle Stengers try to think) all pass, right up until our time, through the confrontation with their technological concretizations—from the steam engine to nanotechnologies and via network computing, the latter being that in which, since 1993, the digital object has been formed.

The system, then, begins to become a reticulated milieu, or what Simondon began to think in terms of a technogeographical milieu[2] and in terms of a mode of existence in the sense of a *type of existence. On the Existence of Digital Objects* investigates of what this specific new type of object consists. As systems turn into reticulated milieus, these technological concretizations of systemic becoming give rise to *functional* challenges—including in the form of *functional stupidity.*[3] If *On the Existence of Digital Objects* does not aim to produce a "system," its concepts are nevertheless derived from various forms of systemic thinking, but also from those automated systems that produce *computational concretions.*

Among these concepts, recursive function is central: recursion is what is implemented by computerized systems of exploitation through algorithms and computational functions—Yuk Hui is first a practitioner and theorist of computer science and the study of artificial intelligence (AI).[4] Furthermore, recursion as characteristic of the *digital object* lies at the heart of the concept toward which this book leads us through investigation of this object, namely, "tertiary protention." By passing through Husserl, Yuk Hui utilizes this concept of tertiary protention to attempt to rethink time, today, as a "new synthesis," after that realism of relations that Simondon himself understood as an attempt to think time.

The digital object is utterly relational. As such, it constitutes, together with the sociotechnical artifacts that are its conditions of possibility (such as the norms and standards of markup languages such as GML, SGML, HTML, or XML), a digital milieu, which cannot be properly understood in terms of what Luciano Floridi calls the inforsphere. Beyond the latter, and as we have already seen, we must pass through the concepts of associated milieu, preindividual milieu, *Zuhandenheit,* and *Vorhandenheit,* but in so doing, *these concepts must themselves be redefined.* This theory of the digital object aims at a new "first philosophy." This is the general context, in terms of the fundamental references from the side of European philosophy, with which Yuk Hui confronts the questions, problematics, and projects of the World Wide Web Consortium (W3C) and the semantic web as thought and promoted by Tim Berners-Lee; of formal ontologies in Barry Smith's sense; of "extended mind" in Andy Clark's sense, and so on.

Returning to the methodological stakes of the work, its immediate conceptual consequences and its ambition mean that it necessarily involves and aims at the very long term. The realization that Simondon's realism of relations turned technical schemas into transductive operators of communication between orders of magnitude makes clear the importance, the audacity, and, ultimately, the enormity of such an approach—and I use the word *enormity* in the sense cultivated by Rimbaud in and through his thought of "voyance."[5]

On the basis of the immense challenges that orders of magnitude constitute in this realism of relations—spelled out clearly by Vincent Bontemps in his analysis of Simondon's course on technics[6]—Yuk Hui tries to literally refound the question of time by questioning Heidegger and, beyond that, questioning Kant and the *Critique of Pure Reason* in relation to the schematism, and by introducing his own fundamental concept of tertiary protention. Before clarifying this point, we should recall that the question of orders of magnitude first emerges in the work of Gaston Bachelard—of whose work Simondon is a thinker, engaging with it in constant dialogue (his other great interlocutor being Canguilhem)—as and through the question of the instrument, inasmuch as it demands phenomenotechnical thought. In the twentieth century, this is what becomes clear in the field of physics, when the theories of relativity and quantum mechanics pose, in a precise way, the question of the relativity of scale.

The concept of tertiary protention echoes what I have myself tried to think as tertiary retention, doing so, again, via a reconsideration of the question of imagination in Kant's first version of *Critique of Pure Reason* (1781). I argued in the third volume of *Technics and Time* that tertiary retention is the condition of possibility of the play between what Husserl called primary retention and secondary retention and that this hidden condition (generated by the technical exteriorization of vital movement on the basis of which André Leroi-Gourhan described hominization as a process of the conquest of space and time through its technicization) is also the condition of the schematism of the understanding, which is itself the condition of the transcendental deduction of the categories.

Yuk Hui shows that digital tertiary retention requires of philosophy and science that they describe this new type of object, the digital object, in terms of digital protention, in an automated milieu itself constituted through algorithmically implemented recursive functions. The algorithmic belongs to the history of what, after Sylvain Auroux, I call a process of grammatization: the digital and thoroughly reticulated milieu is the most advanced stage of this grammatization. This is what the digital object as conceived by Yuk Hui tries to specify: the digital object constitutes what he calls discursive relations. It is on the basis of these discretised relations that the digital object is woven, reticulating itself and thereby establishing its existential relations.

The goal of this enterprise is Simondonian inasmuch as it continues the project of reconciling culture and technics. But it does so in a context in which the opposition and misunderstanding between culture and technics are being staged in a terrible and dramatic way—such is the context of "social engineering" in general, and Facebook in particular, whose regularized schemas form key examples in *On the Existence of Digital Objects.*

The digital object—that is, the computational object—is of technical essence. But it is not reducible to the technical object as Heidegger and Simondon allow it to be thought. Yuk Hui shows that we must go beyond Simondon to think technical individuation if we are to be able to take account of what no longer constitutes a technical milieu but is instead a dissociation at the heart of a dynamic that Thomas Berns and Antoinette Rouvroy describe as algorithmic governmentality, which gives rise to the question of what Evgeny Morozov calls a politics of technology in the context of the data economy.

The digital object remains, from the perspective of the modern thought of the object (or, in ancient times, of substance), highly enigmatic: it is an object neither of experience nor of intuition in the Kantian sense—a status it shares with the scientific objects that emerge from scientific instruments.[7] The digital object may consist of data, *données,* but this is not the result of a donation in the sense this is understood by Jean-Luc Marion, for example, when he revisits the phenomenological conception. Digital objects consist of data, metadata, data formats, "ontologies," and other formalisms that all fall within the process of grammatization, and it is as such that they form a digital *milieu* woven through these relations—alongside other objects. But this implies the possibility not just of an associated milieu but of a dissociated milieu, giving rise to new forms of both individuation and disindividuation. The digital object, formed through recursive functions and thereby constituting a new digital protention, is programmable. This programmability is highly pharmacological (in the Platonic sense given to us in *Phaedrus*), and the question of the therapy and therapeutics required by this digital *pharmakon* amounts to a new question of givenness, that is, of donation.[8]

This is so because human beings exist only under the condition of the anticipation of death, which is a protention they hold in common, but is also their impossible protention (an impossibility in common: death as what will never arrive, as what they will never live through, an indetermination in common inscribed in the heart of noetic life). They record their potential undetermined "protentiality" in tertiary retentions[9] that constitute the network and the milieu of their *Besorgen*—and through which they are constantly threatened with the loss of all *Sorge,* this loss being a forgetting. They must, in other words, externalize their memory in the technics of "language, writing, tools, and gestures," as Yuk Hui recalls, and it is as such that technics constitutes the already-there conditioning the historicity of which Heidegger named *Dasein.*

Hence existential questions do arise in the digital milieu, a milieu in which, as Hui says in chapter 6, "the human mind can make sense of recursion but can hardly keep track of the recursive process." It is a question of what happens when the coupling of man and machine becomes *reticulated* (between many machines and many humans) via digital social networks. And it is precisely on this point, and after having introduced the question of a computational hermeneutics,[10] that the question of tertiary protention arises: Hui states, "When both humans and machines are understood from the fundamental perspective of relations, it produces a new faculty, which . . . I term *tertiary protention.*"

The new form of protention, which passes again through the question of passive synthesis and of repetition in *Difference and Repetition,* results from the industrialization of categories and algorithms. It is in this way that a new synthesis of time occurs, set up by the digital object as tertiary protention, and in this situation, "modern technologies bring us much convenience, but this convenience as an expression of convergence (in terms of functionalities as well as of time and space) also threatens to replace care structures (both individual and collective) with the machine form of 'care'" (chapter 6).

It is, then, a question of "searching for a new structure of care," confronted with what presents itself as a "dividuation" in the sense in which Félix Guattari and then Gilles Deleuze referred to the "dividuals" produced by the analytical grammatization of psychic and collective individuals in societies of control, wherein "the attention of each social atom [is] sliced into ever smaller pieces and dispersed across the networks by status updates, interactions, advertisements—the mechanisms of tertiary protention—for marketing purposes" (chapter 6).

Yuk Hui concludes his book by opening up a perspective that I call organologico-political, a perspective that projects the conditions of possibility of the reconstitution of existential protentions in the digital milieu through the creation of a new architecture of networks of tertiary protentions. In the digital milieu, this possibility depends on inscribing a process of collective individuation formalized by participation in the formation of one or many groups that constitute horizons of existential protentions. Such processes operate through "creative constraint," where "the user can only use the full functions when he or she participates in a group or creates a project" (chapter 6), and thereby enable the constitution of an associated milieu. Hence Yuk Hui replaces the graphs of Jacob Moreno with processes of collective individuation in the Simondonian sense.

This approach thus falls within what, at Ars Industrialis and the Institut de recherche et d'innovation (IRI), we call general organology. The latter is always both theoretical and practical. The works with which Yuk Hui concludes are those he conducted at IRI with Harry Halpin. These works are currently being undertaken from within the perspective of a hermeneutic web, wherein the formation of project management groups—reconstituting existential protentions in and through processes of collective individuation that are also processes of transindividuation—occurs on the basis of a graphical language of annotations that are shared and through which confrontations can be staged, on a contributory hermeneutic platform and in an online educational context.

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Outline of an Investigation on Digital Objects

Humans have always lived in a hybrid environment surrounded by artificial and natural objects. The artificial and the natural are not two separate realms, nor are artificial objects simply instruments with which to conquer the natural; instead, they constitute a dynamic system that conditions human experience and existence. And precisely because the artificial is constantly developing toward greater concretization, it demands constant reflection on its singular historical condition. The milieu in which we live has also changed. Videotapes have been replaced by YouTube videos, and dinner invitations are no longer issued through letters, less and less by telephone calls and e-mails, but more often by Facebook event invitations. These objects are basically data, sharable and controllable; they can be made visible or invisible through the configuration of the system. This book proposes to conduct an investigation of these digital objects. The reader may already have different ideas of what a digital object is, for example, a bug, a virus, a hardware component, a gadget, a piece of code, a bunch of binary numbers. To allow for a more focused investigation, I will limit the scope of this book to data. By digital objects, I mean objects that take shape on a screen or hide in the back end of a computer program, composed of data and metadata regulated by structures or schemas. *Metadata* literally means data about data. Schemas are structures that give semantic and functional meaning to the metadata; in computation, they are also called *ontologies*—a word that has immediate associations with philosophy. The following Figure 1 shows a very simple digital object—a piece of contact information for Martin Heidegger—in which we are presented with metadata that describe the person Heidegger (as someone who knows Bertrand Russell), this metadata being schematized using a Web ontology called FOAF (Friend of a Friend).

Digital objects are, of course, not only limited to contacts; in general, they constitute a new form of industrial object that pervades every aspect of our lives in this time of ubiquitous media—such as online videos,

```
<rdf:RDF xmlns:rdf='http://www.w3.org/1999/02/22-rdf-syntax-ns#'
  xmlns:rdfs='http://www.w3.org/2000/01/rdf-schema#'
  xmlns:foaf='http://xmlns.com/foaf/0.1/'>
<foaf:Person>
 <foaf:name>Martin Heidegger</foaf:name>
 <foaf:firstName>Martin</foaf:firstName>
 <foaf:surname>Heidegger</foaf:surname>
 <foaf:mbox_sha1sum>71b88e951cb5f07518d69e5bb49a45100fbc3ca5</
          foaf:mbox_sha1sum>
 <foaf:knows rdf:resource='#russell'>
</foaf:Person>
<foaf:Person rdf:ID='russell'>
 <foaf:name>Bertrand Russell</foaf:name>
 <foaf:mbox_sha1sum>241021fb0e6289f92815fc210f9e9137262c252e</
          foaf:mbox_sha1sum>
 <rdfs:seeAlso
 rdf:resource='http://rdfweb.org/people/brussell/foaf.rdf'/>
</foaf:Person>
</rdf:RDF>
```

Figure 1. An example of the expression of personal information and friendship in FOAF.

images, text files, Facebook profiles, and invitations. If we look at the Facebook Graph API, which describes how the Facebook data network is formed,[1] we should not be surprised to find that all the elements are defined by the Facebook engineers as objects (Figure 2). They exist both on the screen, where we can interact with them, and in the back end, or inside the computer program. They are quite similar to objects used in object-oriented programming, except that they don't have computational functions. Our inquiry will focus mainly on the general concept of the digital object and the representation and categorization of digital objects, and less on object-oriented programming, which would deserve another book of its own. Despite their popularity, the nature of digital objects is still to be clarified. This assertion is to be understood in two ways. First, philosophical conceptualizations of the object, as developed, for instance, from Aristotle to late modern philosophy, passing by thinkers such as Descartes, Kant, Hegel, and Husserl, have mainly been concerned with questions of the substance and appearance of things, have largely been limited to the understanding of natural objects and have thus been unable to address the question of digital objects. When these conceptual schemas are applied to the understanding of a technical object, such as a machine, they simply treat it as though it were a natural object, such as a tree in the garden. Second, within computer science, a strong notion of the object is

• Album• Application• Checkin• Comment• Domain• Event• FriendList• Group• Insights• Link• Message• Note• Page• Photo• Post• Review• Status message• Subscription• Thread• User• Video

Figure 2. List of objects in the Facebook Graph API.

still lacking, because its use is mostly concerned with the production of data and the harvesting of correlations and patterns (especially in the case of Big Data). Engineering falls short in the sense that it limits its understanding of digital objects to a set of structures for representation (in the sense that form is understood in hylomorphistic thinking), that is, to practical applications. By the same token, reflections on digital media in recent decades have focused on the digital and on information, and increasingly on data, while the notion of the digital *object* is still to be elucidated. In short, digital objects are conceived as pragmatic engineering questions or as phenomena of the digital, whereas their thinghood and their existential status have rarely been brought into question.

To elaborate on the existence of digital objects is the task of the rest of this book. The investigation presupposes a reciprocal relation between computation and philosophy. Some of the questions of computation were already posed as epistemological questions. For example, what is intentionality? What is collectivity? Conversely, computation relies on a new type of materiality that disrupts some of the concepts that are fundamental to philosophy, for example, what is an object? Does a digital object have substance (or is it possible to talk about it in this way)? This dynamic constitutes what I understand as an interdisciplinary mode, which is not a unification of different divisions of labor but rather always presumes their underlying unity. In this introduction, I explain further why a theory of the digital object is needed and how I undertake this task here, presenting my central research questions and methodologies. The remainder of the introduction presents the book's key concerns and is organized according to a reversed order of the title of this book: *object–digital–existence.*

Part I, "Object," paves the path to an understanding of the emergence of digital objects in the history of philosophy. I don't mean by this that digital objects had already been anticipated by traditional metaphysics but rather that as digital objects have emerged as a consequence of historical and technological development, so have they also inherited certain metaphysical presuppositions. I am therefore proposing to identify the digital object as the subject matter of philosophy, just as the natural object and the technical object were before it. I explain the notion of natural object in the phenomenological tradition of Hume, Kant, Hegel, and Husserl, as well as giving an account of the transition to the consideration of technical objects in Heidegger and Simondon, to foreground the consideration of digital objects. I also briefly distinguish this project from Graham Harman's object-oriented ontology, in terms of their respective readings of Heidegger.

Part II, "Digital," introduces the notion of the digital and hence digital objects. I look at the concept of the digital from Leibniz to contemporary thinkers such as Gregory Chaitin and Edward Fredkin, for whom the digital could be understood as a system that can effectively express the world, including its phenomena and its essence. I also contrast Luciano Floridi's approach with Chaitin and Fredkin's digital physics, because Floridi has developed a philosophy of information and has made serious criticisms of their approaches. Finally, I go back to my own notion of digital objects and sketch there a materialist theory of relation.

In Part III, "Existence," I elaborate on the methodology of this study, which comes from a reading of Gaston Bachelard and Simondon, namely, the method of analysis according to orders of magnitude or granularity *(ordres des grandeurs),* and explain its similarities with and differences from the levels of abstractions employed in engineering. With this methodology, we will have a new perspective from which to address the question of existence and the problematic of the existence of digital objects. Existence first presents us with an ontological question concerning beings *(ens, Seiendes)* as actual entities: where do they come from? How are they developed? This has fundamentally to do with formal ontology and formal logic: the former is always present but has also become a specific discipline in the work of figures such as Barry Smith, Nicola Guarino, and others; the latter has always been studied, though followed without being questioned (except among certain mathematicians).

Second, Part III concerns the question of Being *(esse, Sein),* that is, what, really, is an object? What are the meanings of being—there and in their relation to the world and humans? These two terms (being and Being), though both bound to the term *ontological,* are nevertheless in conflict with each other, because they refer to two different interpretations of the world and constitute what Heidegger calls the "ontological difference." The introduction concludes by inviting the reader to engage with the political agenda of this book, which, coming out of the reading of Heidegger's and Simondon's philosophical projects, concerns the search for different modes of reticulation and convergence. As Heidegger and Simondon observed, though the development of technologies is bringing things closer, for example, with the invention of the telephone or the Internet, in fact, it produces opposite effects. For Heidegger, we are moving further away from what he calls the thing *(das Ding),* which is also a profound relation between human and world; for Simondon, the divergence of knowledge production between science and technology, theory and practice, leads to the opposition between culture and technics, and so we need a new philosophical thought to bring society together, hence the technics can be reinscribed in culture.

Object

Natural Objects: Between Substance and Subject

Speaking of natural objects doesn't mean speaking of objects given by nature, such as vegetables or animals. A natural object here refers to the category and perspective in which every object, whether natural or fabricated, is analyzed in the same natural manner. This method proposes that an object can be understood by grasping its essence, which determines its particular being. This process of knowing, at first glance, already presupposes the object itself and the object for knowledge. This leads to the development of a scientific knowledge that works toward an absolute certainty, one that guarantees the correspondence between the thing itself and consciousness. In *Categories,* Aristotle proposes to understand being in terms of substance and accidents. Substance is the subject that underlies a thing and bears the title *hypokeimenon.* He writes, "That which is called a substance most strictly primarily and most of all—is that which is neither said of a subject nor in a subject, e.g. the individual man or the individual horse."[2] Neither is the genre "man" or "horse" substance, because they cannot be observed in the subject; they can be only said of the subject.[3] Accidents are the predicates of the subject. Clearly, in *Categories,* Aristotle designates the subject–predicate pairing both as a grammatical structure and as a system of classification. The relation between language as classification and things as physical beings is already established: the primary substance in *Categories* remains a universal "this," which is a composition of both matter and form.

Aristotle gives a more detailed, though somewhat divergent account of substance in *Metaphysics (book Z),* where he says that the question "what is being?" really amounts to "what is substance?"[4] Here substance takes the title of essence (οὐσία). He then proposes to understand the substance of the substratum. The substratum can be described in terms of sensible form and matter. Sensible form is concerned with "what kind of thing" a thing is, and matter concerns "what it is made of." Aristotle proposes to decide which of the three elements—form, or matter, or the composite of form and matter—can be called substance. Aristotle rejected both matter and the composite, the former because it can be a predicate of the subject, and the latter because it is "posterior in nature and familiar to sense."[5] He finally decided that form is the sole acceptable way of understanding the substratum.

It is worth noticing here that Aristotle used the word *eidos* instead of *morphe* for form. Aristotle uses *eidos* when he refers to an artificial object, for example, when an architect has the form of a house in mind, hence οὐσία, as τὸ τί ἦν εἶναι (what it already was) is closely related to *eidos,* and he uses morphe in the general understanding that being is composed of *form* and *matter.*[6] There are two points we should note here: first, that the question of substantial form became an enduring philosophical question concerning the essence of things and their representation, which present at the same time a determination of both matter and intellect, and second, that the subject and object distinction did not come to be made until Descartes, so that until this point, the thing under contemplation is a subject but not an object. The concept of subject as distanced from thing in favor of its association with the ego that contemplates it is characteristic of a separate yet also long-running mediation between subject (consciousness/noesis) and substance (essence).[7]

The subject–substance question can be understood as the core question of the philosophical conceptuality of natural objects.[8] Instead of engaging with its further development in medieval philosophy, I propose to move directly to consideration of the phenomenological approach as it developed from Hume to Husserl, which always understands the object as an object of experience. The trajectory pursued will aim to sketch out the metaphysical foundations of natural objects. It will also explain why the phenomenological tradition fails to comprehend technical and digital objects. British empiricism has always been skeptical of substance because this tradition already presupposes that phenomena should be understood as bundles of empirical sense data. An earlier empiricist such as John Locke therefore questions the existence of substance yet remains indecisive regarding it and leaves the question open.[9] Hume, however, totally rejects the idea of substance. His argument runs like this: every idea is developed from sense impressions; this necessarily entails encountering something, giving rise to a moment of knowing. If substance can be known, then we should have an idea or impression of substance, yet this impression is absent. From this point, Hume takes substance out of his philosophical analysis because it is something that cannot be demonstrated. Knowledge of a thing, according to Hume, results from the synthesis of sense data through associations. He proposes a system of relations based on which the bundles of sense data are able to give us a sense of the object's unity. Hume's theory of relations, as I propose in chapter 3, can help shed new light on the understanding of digital objects. But Hume's relations lead to a passive synthesis, as if they come into being automatically, and he is not able to explain the necessity of such a unity.

Kant attempts to solve Hume's puzzle and reconcile empiricism with rationalism in his *Critique of Pure Reason.* Kant proposes a formal structure, which he argues underlies the conditions of possibility of experience. The formal structure for Kant is transcendental, meaning it is outside of the empirical field. In this work, Kant proposes that a synthetic a priori is possible. This is a contradiction in terms from the perspective of either empiricism or rationalism. For empiricism, every experience is a posteriori, hence synthesis, as something empirical, cannot be a priori. For rationalism, in contrast, what is a priori is outside of the empirical field and thus necessarily transcends experience. Here the formal structure serves a system of a priori functions leading to a synthesis that is also formally a priori. In Kant's architectonic in *Critique of Pure Reason,* this formalism is divided into three parts: the first is the transcendental aesthetic, which proposes time and space as two pure intuitions; the second is the transcendental analytic, which carries out the transcendental deduction and proposes the categories of understanding; and the third is the transcendental dialectic, which concerns the use and misuse of pure reason. Kant's categories are divided into four groups, in which the last categories are the syntheses of the previous two. These categories work as schemata, while

QUANTITY	QUALITY	RELATION	MODALITY
Universal	Affirmative	Categorical	Problematical
Particular	Negative	Hypothetical	Assertoric
Singular	Infinite	Disjunctive	Apodictic

Figure 3. Kant's twelve categories of judgments.

sense data are subsumed under them and concepts are created through the process of transcendental apprehension. This process of understanding produces two distinct interpretations, which we will deal with in detail later. The first interpretation is adopted by ontologists and computer scientists. It involves the creation of prosthetic schemata, for example, the metadata scheme, which produces the object through its intrinsic logical functionalities.[10] The second interpretation takes a very different approach from the first. It follows that of Martin Heidegger in *Kant and the Problem of Metaphysics,* which proposes to understand it as a temporal process rather than a logical operation.

Kant's efforts to lay down the conditions of possibility of experience is nevertheless a conservative move, because for Kant, the question of substance still cannot be fully answered. It appears under another name as the "thing-in-itself" *(Ding an sich),* which takes shelter in the realm of noumena instead of in the domain of phenomena. What we can know of the object of experience according to Kant is only phenomenal experience, that is to say, the sensibles of the object, while we are not able to grasp what is really in the thing itself. This ability would demand an intellectual intuition that is lacking in human beings and only present in God. Kant proposes here the finitude of knowledge because its certitude is limited to the realm of phenomena and hence leaves room for faith. This conservative move was criticized by philosophers like Fichte and Schelling, who came after Kant, and, most powerfully and influentially, Hegel.

In Kant we see a separation between the knowledge of the object and the object itself. Knowledge is part of our experience within the objective world. The object becomes known when a bundle of sense data are synthesized. The transcendental faculties present themselves as a system of instruments, which renders perception and synthesis possible. Hegel, like Fichte and Schelling, refused the idea of the thing-in-itself as unknown;

indeed, Fichte and Schelling reproached Kant and proposed the intellectual intuition as fundamental to any human knowledge.[11] Hegel refused the intellectual intuition as the absolute beginning[12] and proposed a reconciliation between substance and subject through the dialectical movement of the in-and-for-itself. Hegel's motivation is the same as that of the Enlightenment philosophers, who saw themselves as working within a scientific spirit of philosophy, seeking to reconstitute philosophy as a true science. In opposition to Kant, Hegel restores the importance of reason to the full articulation of constitutive concepts.[13] In Kant, as we saw, understanding serves as a formal structure that allows the transcendental apprehension of objects, while reason has no role in this process besides serving as a reflection of it. Recognizing that Kant's understanding is formal and empty, Hegel proposes that speculative reason is the starting point from which to move toward true experience. Knowledge for Hegel is not the instrument or means by which to analyze objects. Rather, knowledge itself,[14] especially philosophical knowledge, is truth and absolute. Hegel formulated this proposition at the beginning of *The Phenomenology of Spirit* to overcome directly the discrepancy between the thing-in-itself and consciousness.

It is worth considering Hegel's proposal at this point, as will be relevant to our discussion later on. Against the empiricists and against Kant's proposal that objects appear as a result of the synthesis of bundles of sensation, Hegel understands an object to be a whole. His proposition is made clear in the lesser *Logic,* in the third division concerning the *Development of the Object.*[15] Hegel finds the mechanical and chemical view insufficient and proposes to approach the object through its totality. The bundle theory itself is insufficient because it calls for a mechanical system able to synthesize the data through logical operations and procedures. The bundle theory, or atomism, if I can call it as such, has then been totally absorbed in computation. Hegel therefore seeks to give us a new system that will show how this whole is given as the appearance of the object. An excerpt from *The Phenomenology of Spirit,* the introduction of which was paraphrased by Heidegger paragraph by paragraph in his lecture "Hegel's Concept of Experience," gives us a clear picture of what Hegel proposes as the perception of unity (not only the unity of perception)[16] and the dialectical movement toward the Absolute. The object we experience in our encounter already enters consciousness as the being for us. The distinction between the in-it-self of the object and our consciousness of it is overcome, according to Hegel, by "the nature of the object which we are investigating. Since consciousness provides itself with its own standard, the investigation will be a comparison of consciousness with its own self."[17] What Hegel means by overcoming the opposition is actually the step of moving the substance to the plane of the subject. Now the object exists as an object for us, and it is immediately present as two different identities: the in-it-self for consciousness and the knowledge of itself in consciousness.[18] Reason's examination of these two produces the second in-itself for consciousness. This understanding of experience presupposes from the very beginning that the in-it-self of the object is already retained and that reason's role is to undergo a dialectical movement to arrive at its concept *(Begriff)*. The Absolute, is not an absolute Absolute but a differentiated Absolute marked by the subject's self-consciousness, especially when we consider Hegel's concept of history as the history of the progress of self-consciousness.

Compared with his philosophy of history, which gained much more attention through Marx, Hegel's phenomenology as a science of cognition has not been developed much further besides in historical studies on idealism. Instead, another type of phenomenology came to the fore, founded by Edmund Husserl and known as *descriptive phenomenology.* The very use of the word *description* clearly distinguishes Husserl from Hegel. For Husserl, phenomenology is a descriptive process that goes back and forth to depict the object through the knowing of consciousness, whereas for Hegel, phenomenology is a speculative process in which multiple stages of self-consciousness are attained through dialectical movements and sublations. However, they are not totally separated, because Husserl's phenomenology is another investigation into consciousness and an attempt to provide the absolute foundation of all science. From this perspective, Husserl and Hegel share the same ambition.[19]

Husserl's phenomenology also rejected Kant's thing-in-itself as being a mystery and proposed that we can actually know the object through the movements of intentionality. Because Husserl starts as an arithmetician, subsequently becoming a philosopher of logic and consciousness, and finally a philosopher of culture, it is almost impossible to summarize a theory of the object in a way that captures his entire understanding. But in a nutshell (because Husserlian logic will be explained in detail in chapter 5), Husserl regards everything as a possible intentional object; for example, a number is just as much an object as an apple. Husserl's project is directed against what he called naive realism and relativism: an object for Husserl is not what it is given; rather, this given is constituted by a genesis of the senses. To relinquish naive, the phenomenologist starts with *epoché,* meaning the bracketing of any presuppositions and bias, which already constitutes the object as such. The bracketing process, to Husserl, is also a process of returning to an absolute ego that is free from any presupposition. An intentional act then comes into being directed from the subject to the object, and the reflection that this act effects constitutes a horizon on which the ideality of the object appears. This ideality is only possible through a process of ideation, which reconstitutes the horizon of meaning.

The trajectory of the modern philosophies of objects demonstrated by these key figures mentioned opens up several general directions for the investigation of objects. First, there is a wavering skepticism regarding the concept of substance. The transcendence of substance finds its place in God; in other words, substance hides in the emanation of God and is therefore beyond human experience. The risk involved in an absolute knowledge of the object easily leads to the destruction of the transcendent plane by bringing it down to the plane of immanence. This philosophical trajectory also accompanies the scientific spirit in working toward the discovery and reassurance of the power of scientific methods. Second, consciousness is the ultimate mystery, and no authority can describe for itself the ultimate, eternal truth. These multiple models attempt to comprehend the mind, and they assign different mechanisms to it. This is important, because the mind is the same as the object of inquiry (even if it is much more complicated), and we can also pose the question of the thing-in-itself of the mind just as we may do for a fillet of steak or a cauliflower. In Hume, Kant, Hegel, and Husserl, it is not only that consciousness is imbued with specific functions, which are also systemized as part of an *organon* of knowing (although none of them would admit the applicability of the word *organon*). Third, the role of knowing falls totally to the mind. The other side of the coin is that objects are always objects of experience. The predicates of the objects are qualities that can be experienced, so all of the preceding philosophers are eager to find the structure of consciousness that would allow it to know the object, whereas they undertake less investigation into the object's own existence and how its existence conditions the process of knowing and being itself.

Technical Objects: From Substance to Milieu

The dialectics of substance and subject has been debated between realism and idealism. Technological unconsciousness in philosophy has meant that it has failed to absorb the rapid development of technology and social change after the Industrial Revolution. The idea of the philosopher as a figure who stands outside as mere critic and defends the purity of thought and inquiry into human nature has been washed away in the flux of technological progress. It is possible to argue that most of the philosophers mentioned earlier, except Husserl, came before the Industrial Revolution and therefore dismissed technical objects. Technical objects here are not necessarily complicated machines; a hammer or a knife is also a technical object. Indeed, Husserl, the philosopher among those discussed who did witness the rapid proliferation of machines after the Industrial Revolution, didn't take them into account in his phenomenological theory.[20] A new philosophical attitude as well as a new philosophical system must be constituted to comprehend the changes that this process entailed.[21] If ontology starts with the question of being, then there is a problem in that the understanding of being is not on the right path if it does not take into account the nature of technics. And this is very clear if we follow Heidegger's proposition that the beginning of cybernetics is the end of metaphysics.[22] I will therefore propose two figures who may bring the concept of technical objects to light and prepare the ground for our investigation of digital objects: the French philosopher Gilbert Simondon (1924–89) and the German philosopher Martin Heidegger may appear at first glance to be incompatible, as Simondon is an admirer of modern technology, whereas Heidegger is known as a philosopher who was opposed to it. The reconciliation between Simondon and Heidegger will be proposed in chapters 3 and 4, but here I briefly note how Simondon and Heidegger addressed different aspects of the nature of technical objects.

Simondon in *On the Mode of Existence of Technical Objects* (1958), proposed what he calls a *mechanology.* Mechanology investigates the existence of technical objects through its evolution and the relation between objects and their milieu, with an ultimate aim to resolve the problem of industrial alienation, which is resultant from the misunderstanding and ignorance of technologies. Simondon's ambition was not to add one more branch to philosophy but rather to reestablish the metaphysical foundation of philosophy as a whole. His project started with the rejection of hylomor-

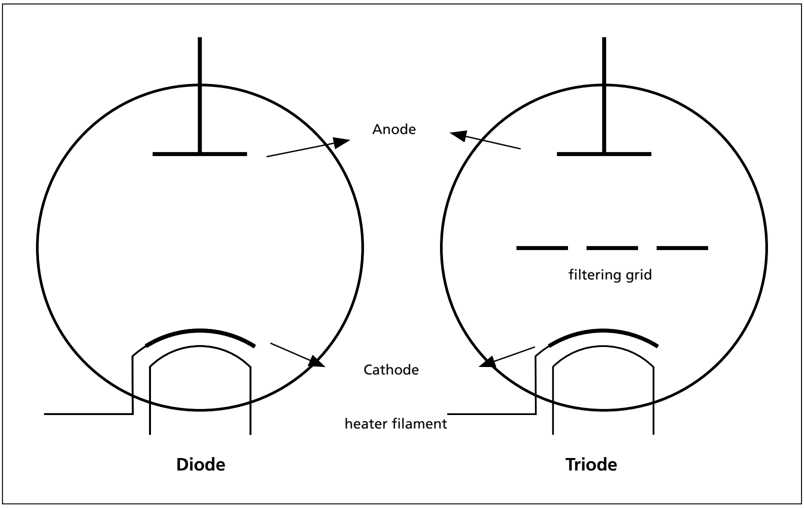

Figure 4. An indirect heated vacuum tube diode and triode.

phism, which considers objects in terms of form and matter. We could also say that hylomorphism is closely related to substance–predicate thinking, because it is an already individuated form that gives matter its essence. Instead of forms, Simondon proposed to understand technical objects through the *modulation* of causal relations of different parts. He showed how these relations are constructed in a process going from technical elements to technical individuals and then to ensembles. Simondon calls this evolutionary process the concretization of technical objects. We can understand what he means by concretization from the example of the evolution from the diode to the Lee de Forest triode. The triode is an evolved version of the diode, which is a device that controls the flow of current in a single direction. In its simplest form, within a vacuum tube, the cathode is heated and hence activated to release electrons. The anode is positively charged so that it attracts electrons from the cathode. When the voltage polarity is reversed, the anode is not heated and thus cannot emit electrons. Hence there is no current passing through. A triode places a grid between the anode and the cathode; a DC current can give a bias to the grid: if it is negative, it will repel some of the electrons back to the cathode and hence serve as an amplifier. Simondon proposes that the absolute beginning of the triode is not the diode but is to be found "in the condition of irreversibility of the electrodes and the phenomenon of the transport of electric charges across the vacuum."[23]

A technical individual is a technical object that supports the functioning of its inner structure, at the same time as it is able to incorporate an external milieu into its functioning. This external milieu is what Simondon calls the associated milieu *(milieu associé),* which provides a stabilizing function that restores the equilibrium of the system itself. Simondon's approach to technical objects differs from those of previous philosophers and phenomenologists in that he does not reduce the technical object to the intentional defect of consciousness, making it an object for knowledge. He proposed to study the genesis of the technical object itself in terms of the degrees of concretization and develop a philosophy that is compatible with technical objects. A technical object regains its materiality and attains a different degree of concreteness or perfection in contrast to what cybernetics terms "control." Simondon also noticed that the concretization of technical objects allows them to move toward the status of natural objects:

> The concrete technical object, that is to say the evolved, comes close to the mode of existence of natural objects, it tends towards an internal coherence, towards the closure of the system of causes and effects exerted circularly inside its enclosure, moreover it incorporates a part of the natural world that intervenes as condition of function, and therefore takes part in the system of causes and effects.[24]

A technical object, if we can understand it ontologically, is a unity of relations. Indeed, Simondon uses the word *relation* frequently without categorizing it. We can say that the object's perfection is also the development of its relations. The relations of a technical element are limited to its internal operation. Consider, for example, the diode, which is regulated by voltage and polarity: when it becomes an individual, it extends its relations to an outer milieu and makes these relations an indispensable part of its identity. In *On the Mode of Existence of Technical Objects,* Simondon sees individualization as the method by which to peep into the evolution of technical objects and its relation to the human world. Here we need to distinguish two words Simondon used: *individualization* and *individuation.* Simondon talked about the individualization of technical objects, but not about their individuation. Individualization concerns functions:

somatic specializations and psychic schematization; when the term is applied to living beings, it denotes the development and division between the psychic and the soma. Individuation, conversely, concerns the genesis and resolution of tensions to arrive at a metastable equilibrium, which expresses as phase changes. We can probably say that individualization demands a hierarchy that puts different elements into a functioning order, whereas individuation produces, not a hierarchy, but rather a "hierarchical relativity."[25]

Simondon frequently explains individuation with the example of crystallization.[26] Consider a saturated chemical solution, for example, sodium chloride (salt). Before it crystallizes, the saturated chemical solution is in a metastable state, which means that it is highly unstable. When it is subjected to a small amount of heat, it starts to crystallize. Modern chemistry has taught us that new bonds are established between the ions in a regulated pattern to minimize the repulsion between negative ions, and this pattern is extended progressively throughout the sodium chloride solution. In the crystallization process, there is no single identity, and those that are already crystallized serve as the foundation and catalyst for further crystallization (by releasing heat). Individuation demands three types of conditions in this case (and in general): (1) energetic, (2) material, and (3) informational and generally nonimmanent. These three conditions could be understood through relations, because Simondon proposes that "relation is not an accident related to a substance, but a constitutive, energetic and structural condition that goes on in the existence of the constituted beings."[27] Following Simondon, we can talk about the individualization of the digital object, which is the task of chapter 1, through an investigation of the history of markup languages. But in contrast to Simondon, I propose to understand the individuation of digital objects. This has been a focus of speculation that has preoccupied me for some years: what motivated Simondon to write his supplementary thesis *Du mode d'existence des objets techniques* (1958) after the main thesis *L'Individuation à la lumière des notions de forme et d'information* (the two parts of this book were published separately under the titles *L'individu et sa genèse physico-biologique* [1964] and *L'individuation psychique et collective* [1989]), in which he kind of moved from the richer notion of individuation to individualization? I cannot devote too much space in this book to scholarly explanations for this historical development, but I would like to emphasize that I consider it to be central to the political agenda of Simondon, which is to overcome the alienation caused by technological development (this is stated on the first page of the book and reappears throughout). If we want to address the human–machine–world relation, then some thoughts on the individuation of digital objects have to be posed both philosophically and politically. This necessity, which was not made explicit in Simondon's writings, will be pursued in this book.

I believe Heidegger provided a way of understanding relations that contrasts with that of Simondon, yet one that may provide us with some useful conceptual resources for the task of figuring out a theory of the individuation of objects. Heidegger himself would immediately reject such a claim and did indeed doubt the fruitfulness of a theory of relations in *Being and Time.* However, I will demonstrate in chapter 3 why I conceive Heidegger to be a philosopher of relations in parallel with Simondon. Heidegger's contribution to the understanding of technical objects can be found in *Being and Time,* where he talks about the "ready-to-hand." Heidegger proposes two categories: ready-to-handness *(Zuhandenheit)* and present-at-handness *(Vorhandenheit).* We can understand present-at-hand as a mode of comprehension that renders a thing an object for consciousness and attempts to arrive at the essence of that object (as in the case of a natural object). Ready-to-hand is a mode of interaction, in which we put aside the question of ideality and objectivity and let the object appear to us according to its functionalities. We see a similar impulse in Simondon and Heidegger here, in which the understanding of an object is characterized by a move from substance to external milieux. The difference between them is that Heidegger bypassed the technical milieu and concentrated on the milieu of signification, interpreting the object's self-manifestation within the milieu in terms of *relations.* For example, Heidegger illustrates the way we use a hammer: we don't really need to achieve an ideality of the hammer (as present-at-hand) before we use it; we just grasp it and use it to hit the nail into the place it is intended to go. This everyday practical activity moves away from the concept of experience as a mere activity of consciousness. It argues that the previous understanding of objects, which subsumed them under cognition, ignores the dynamic relations between both objects and *Dasein.* For instance, Husserl's concept of intentionality, according to Heidegger, when properly understood, is nothing but the awareness of being-in-the-world; that is to say, it is not a ray projected from the ego but a field of relations that the ego has to follow.

In the preceding conceptualization, both Simondon and Heidegger propose going back to the objects themselves. I have to admit that I am cheating here. For I have bypassed Heidegger's distinction between object *(Gegenstand)* and thing *(Ding),* and his critique of modern technology. This distinction will be discussed in chapters 2 and 4. "Back to things themselves" *(zu den Sachen selbst)* was the well-known slogan of Husserl's phenomenology. But Husserl's approach, as I briefly mentioned, still falls back into the paradigm of struggle between subject and substance. "Back to the technical objects," a slogan I attribute implicitly to Simondon and Heidegger, aims to bypass the solipsism of traditional metaphysics and allow the objects to *be* without a mediator. Both Simondon and Heidegger point to the question of relation as a metaphysical understanding of technical objects. For Simondon, it is the relation in and between the internal and external that constitutes the dynamic of its individualization. For Heidegger, it is the relations of the world that constitute the degree of freedom for both things and human *Dasein.* Here we see that Simondon's concern for technicity and Heidegger's for the world supplement each other. And I propose that this connection will be able to open up a new perspective. Yet this project remains open, and it becomes a fundamental question for our investigation into the existence of digital objects.

This reading of Heidegger in terms of relations fundamentally distinguishes our project from that of Graham Harman's object-oriented philosophy. Harman's work resonates with this project because he also developed his theory from a reading of Martin Heidegger's ready-to-hand and present-at-hand. Indeed, my first encounter of objects and relations was through personal correspondence with Harman in 2007, yet I developed a very different understanding from Harman's. For Harman, every object is a tool-being. Every tool-being is real and cannot be reduced to atoms or smaller physical entities. I share a similar view that the current understanding of information or even data as flow as the constitution of the digital object is possible but not sufficient, but I prefer to understand them as different orders of magnitude. Nevertheless, I would like to mention two points that fundamentally separate these two projects:

Substance. Harman understands Heidegger to have developed the concept of a new substance.[28] I contest that substance is not a question for Heidegger, because the substance–accident pair for him is the beginning of the fault of Western metaphysics. In this project, I refuse totally the concept of substance. Heidegger's task is to replace substance with temporal relations, which are not fixed entities but the dynamics of care *[Sorge].*

Harman rejected this by saying that Heidegger never had a philosophy of time.[29] For my reading, if there had been a new substance Heidegger wanted to invent, then it would have had to be time. Indeed, this thesis follows Heidegger in that time is a key issue in the attempt to understand digital objects.

Relations. Harman tries to understand nonrelation instead of relations, for example, when the object is used as ready-to-hand, it withdraws itself not only from *Dasein* but also from other tools.[30] The Heidegger whom we want to retrieve in this project is a philosopher of relations. Both *Zuhandenes* and *Vorhandenes* express different relations; the former is time, or what I call existential relations, and the latter refers to properties, which I call discursive relations. Harman doesn't clearly explain what he means by relations. In his book on Bruno Latour, Harman characterizes Latour as the metaphysician of the network and relations, but these relations seem to be a kind of force acting from one actor on another without concrete analysis. He even makes the provocation that the black box (the unknown causality that the network of actors works) is the new substance. This ambiguity of substance and relations[31] may give us irreductionism, but it also gives us a metaphysical black box.

Because of these fundamental differences, this book sets out to outline a speculation of digital objects and a realism of relations with a different point of departure, instead of directly engaging with Harman's speculative realism, though I am aware that there are also different approaches within this school of thought concerning objects, notably as found in Ian Bogost's *Alien Phenomenology* (2011), Levi Bryant's *The Democracy of Objects* (2011), and the recent works of Timothy Morton. The efforts of these authors are well appreciated, but it will not be possible to respond to all of them here (such would effectively mean changing the subject of this book).

Digital

Digital Physics and Computational Metaphysics

I hope it is clear from the preceding exploration that the philosophical investigation of objects underwent a shift following the onset of industrial modernity, from what I generalized as the natural object to the technical object. Here I propose that, correspondingly, a new inquiry into the digital object now needs to be carried out. We have many brilliant works that have opened up some very interesting and important lines of inquiry concerning the concept of the digital, notably Leibniz and the modern logicians and engineers, such as Frege, Hilbert, Turing, Gödel, and more contemporary thinkers, such as Edward Fredkin, Konrad Zuse, Stephen Wolfram, Gregory J. Chaitin, Luciano Floridi, and many others to name. The notion of the digital has been known since Leibniz, if we understand it in reference to abinary systems. In fact, Leibniz is a figure of fundamental relevance to the foundation of computer science today. In 1669, in a three-page manuscript titled *De Progressione Dyadica,*[32] Leibniz already outlined the possibility of using a binary system to perform operations of division and multiplication. We can probably understand two notes of significance in this invention: the first would be its role in calculation, because it effectively reduces representation using ten digits to a system using two; the second is associated with what he later calls *Characteristica Universalis,* which is a system of signs *(Zeichensystem)* that can fully express all concepts and things in themselves. It is known that Leibniz's binary system and *Characteristica Universalis* were largely inspired by Chinese writing. Through his correspondence with the French Jesuit Joachim Bouvet (1656–1730), Leibniz discovered the *I Ching* and was surprised to find therein a binary system that had already been in existence for millennia. Leibniz understood the binary system as the first ideographic *writing,* seeing the later Chinese writing as a further development of the ideogram. Differing from the phonographic nature of European languages, Chinese writing is ideographic. Considered in this way, Chinese writing prefigures the *Characteristica Universalis,* because it uses a set of limited signs to express the world. The *Characteristica Universalis* is not only mathematical but also metaphysical and theological, because it deals with the construction of a theory of expression, which is the centerpiece of metaphysics *(comme pièce centrale de la métaphysique)*.[33] This theory of expression is also at the same time the theory of relations, or more precisely, logical relations. We develop this point further in chapter 3. Chaitin, one of the pioneers of algorithmic information theory, understands Leibniz as a fundamental thinker who announced four hundred years ago the project of the computational universe.[34] He cites a passage from Leibniz's *Discourse on Metaphysics*:

> God has chosen the most perfect world, that is, the one which is at the same time the simplest in hypotheses and the richest in phenomena, as might be a line in geometry whose construction is easy and whose properties and effects are extremely remarkable and widespread.

This is fundamental to any program that wants to express the world: it must always seek to be "the simplest in hypotheses and the richest in phenomena." Central to the idea of the *Characteristica Universalis* is the question of how to express the world with limited signs. It was one of the reasons Leibniz was excited by Chinese writing and fueled his endeavor to discover a writing system more general than that of the Chinese characters. For Chaitin, likewise, it is necessary that the algorithm that is used to represent a particular set or type of data should be smaller than it. Chaitin also made the playful proposition that the name "bit" should be changed to "Leibniz."[35] Leibniz's mathematical and philosophical insights led to the later development of formal logical systems and calculating machines. This history is revisited in chapters 5 and 6 of this book. It is probably in terms of this historical trajectory that we can best understand the ideas of some digital thinkers, for example, Wolfram's computational universe and Fredkin's digital physics or digital philosophy. Let me single out here some of the basic ideas of Fredkin's project, which were clearly laid out in his article "An Introduction to the Digital Philosophy." In the abstract, he wrote,

> DP is based on two concepts: bits, like the binary digits in a computer, correspond to the most microscopic representation of state information; and the temporal evolution of state is a digital informational process similar to what goes on in the circuitry of a computer processor. We are motivated in this endeavor by the remarkable clarification that DP seems able to provide with regard to many of the most fundamental questions about processes we observe in our world.[36]

Fredkin, as he himself says, has pushed atomism to an extreme by assuming "that everything is based on some very simple discrete process, with space, time, and state all being discrete."[37] According to this vision, physical laws have to be computationally universal, because they will form the basic model that explains the world with algorithms of limited sizes. This worldview comes out of quantum mechanics, in which the energy levels of atoms are discrete. The operations of bits could be further grasped by two mathematical models, one being diaphantine analysis, an area of number theory that determines integral solutions of certain algebraic equations, the other automata theory, which studies self-operating virtual machines, an area Wolfram further advances.

Philosophy of Information

This reflection on the digital is not the whole story. The philosopher of information Luciano Floridi made the criticism that the digital ontology sets up an opposition between the analog and the digital, because if the world is understood digitally, there will be no place for the analog, which we still experience every day. Instead of understanding the world as discrete and atomic, Floridi proposed to think of it in terms of information. Floridi, in his article "Against Digital Ontology," shows that digital ontologists have largely ignored different levels of abstraction, a method that he adopted from engineering.[38] To put it in simple terms, the level of abstraction is a method for modeling a system with a given set of data. The observer can have different levels of abstraction depending on her "division" or "cut" of granularities. The problem with the digital ontologists is that they ignore that there can be different levels of abstraction, instead insisting on there being only one, which is digital. In comparison, Floridi provides an approach that at least acknowledges human experiences besides affirming the importance of information in computation. Floridi's work is important for the study of the digital because he takes the notion of information much further, moving it beyond computation and cybernetics, and attempts to construct a general philosophy of information.

Information, in cybernetics, is something almost ungraspable; however, it can be communicated and measured by bits and by entropy. The founder of cybernetics, Norbert Wiener, famously stated that "information is information, not matter or energy. No materialism which does not admit this can survive in the present day."[39] Claude Shannon and Wiener gave two different interpretations of the term *information.* For Wiener, information is the measure of organization, as opposed to entropy, which is the measure of disorganization. Meanwhile, for Shannon, information indicates the level of surprise and uncertainty: a surprise occurs when there is a difference between the expecting (anticipation) and the expected (outcome). As Shannon's collaborator Wallen Weaver pointed out, "the quantity which uniquely meets the natural requirements that one sets up for 'information' turns out to be exactly that which is known in thermodynamics as entropy."[40] We can see that Wiener's and Shannon's information have opposing significations, amounting to two totally different sets of qualities. Floridi goes further in showing that information must be reappropriated and moved from machines to the world, that is to say, by demonstrating that computation is only part of the philosophy of information. Hence he calls the world in which we are living after digitization the "infosphere," its name deriving from the word *biosphere*:

> "Infosphere" is a word I coined years ago on the basis of "biosphere," a term referring to that limited region on our planet that supports life. By "infosphere," then, I mean the whole informational environment made up of all informational entities (including informational agents), their properties, interactions, processes, and relations. It is an environment comparable to, but different from, "cyberspace" (which is only one of the sub-regions of the infosphere, as it were), since the infosphere also includes offline and analogue spaces of information.[41]

Floridi recognizes that this infosphere is radically reshaping our world, because it "both enable[s] us to create fundamentally new substances that didn't previously exist and enable[s] us to interact with and manipulate the world in previously unimagined ways."[42] Floridi even proposes a new human called an "inforg," in contrast to the well-known cyborg.[43] In contrast to the computational universe, which is atomic, discrete, and universal, now the world is informational. Floridi makes a classification into mathematical information, semantic information, physical information, biological information, and economic information and has developed an ethics of information. Considering closely the theoretical background of both digital ontology and the infosphere, while both have made gestures toward new kinds of philosophical thought and new inquiries, ultimately, they do not seem to have moved too far away from the established paradigms of abstract modeling and formal logic.

What is commonly agreed upon in both viewpoints is that information is an abstract entity, existing outside of materiality as well as being a mathematical entity following the mathematical theory of communication. Nonetheless, such an understanding of information is inadequate to describe our situation, as it already presumes human experience to be a matter of calculus and the human to be a cybernetic (if not already computational) machine. It is worth mentioning that Simondon has also developed a general theory of information, which differs from the cybernetic model. Besides of quality and quantity, Simondon understands information as signification, and I further showed elsewhere that beyond signification, there is also the notion of significance, which defines the threshold of individuation.[44] We will touch upon Simondon's theory of information in chapter 5; now let's return to Floridi. I think that Floridi's challenge to the digital ontologies provides new ways of looking at computation, but I also wonder with regard to both theories whether it will be possible for us to retain the notion of objects without being submerged in the ocean of the digital and information. Throughout our everyday life, we continue to interact with objects alongside information, inducing experiences of embodiment, sensation, affection, desire, and so on. Objects cannot be totally reduced to information, just as Floridi argued that the world cannot simply be reduced to atoms or bits and signals. Floridi's use of levels of abstraction amounts to a very pragmatic method that opens up a pluralism that is overshadowed by monistic view of atoms and the digital. In fact, in the following section, we will see that the method I use throughout this book, the order of granularities, is very similar to his adoption of the levels of abstraction, yet there we will also see some significant differences.

Digital Object: Material Relations to Technical Systems

Can we find another approach that allows us to make an investigation of digital objects? I have already hinted (at the end of the section on technical objects) that it will be important to pick up the concept of relation again. Nonetheless, there is no explicit systematic approach to relations in the thoughts of Simondon and Heidegger. In fact, in chapter 3, we see that Heidegger even rejected the task of developing a theory of relations. I tend to argue that it was not philosophical thought itself but rather the development of both science and technology based on the substance–predicate paradigm that fomented a relational thinking as well as the disillusionment with substance–predicate thinking. That is to say, the substance–predicate mode becomes a negation of itself. This logic was discussed by Jean-François Lyotard in his theory of the postmodern. Science and technology were the project of the modern; however, at certain moments of their development, they also exposed the limits of the modern—the will to master—while the postmodern reveals the unstable, unpredictable nature of the universe.[45] History expresses a contradiction against its own logic. Likewise, the emergence of quantum mechanics by the end of the nineteenth and beginning of the twentieth centuries showed philosophers the problems with thinking in terms of substance. Objects exist in different orders of reality. We can observe an object in terms of its color, shape, and texture; we can also describe it in terms of atoms, electrons, or smaller particles. How, then, can we articulate the substance in microphysics? Bachelard proposed to replace the word *substance* with *existance,* on the basis that the former term is useless and dangerous.[46] Bachelard's new epistemology centers on the concept of relations: these relations will actualize according to certain technics or instruments of observation. In his article "Le Monde comme caprice et miniature" (1931), Bachelard wrote that "at the beginning was relation" *(au commencement était la relation)*.[47] Bachelard also considered this new way of looking at things in terms of relations a task and a challenge for metaphysics:

> It is in this pellicle that relations with the exterior determine a new physic-chemistry. It is there the metaphysician could understand the best how the relations determine the structure.[48]

In parallel, the discovery of relations in logic and its realization in computational technologies also uncovered the problematic aspects of Aristotelian ontology. This was made explicit by the discovery of relational calculus in mathematics and later in the invention of the relational database. We can observe that though engineers and philosophers of computation use technologies of relations, they tend to continue using the word *substance* without really understanding objects relationally. The most important difference between digital objects and technical objects, in this regard, is that whereas, on one hand, digital objects have sped up the collapse of what Peter Sloterdjik characterizes as the "substantial fetishism" of occidental metaphysics,[49] on the other hand, the concretization of digital objects has also brought us a technical system consisting of materialized relations, in which everything has the possibility to connect to other things. Compared with earlier technical ensembles that largely relied on referential relations or signification, as we have seen in Heidegger's example of the ready-to-hand, the technical system is created through digital objects (the Web) that constantly transform referential relations in material forms. At the center of this view of technical evolution is what I address in chapter 4 under the name of "interobjectivity." Digital objects are at the same time logical statements and sources for the formation of networks. They are not only a philosophical conceptualization but indeed concrete objects. Bertrand Russell, in *The Principles of Mathematics,*[50] dedicated several chapters to relations. Russell criticized the fact that mathematics has inherited the philosophical error whereby an object has to be thought of in terms of subject–predicate propositions. Instead, Russell proposed to move relation out of the Aristotelian ontology:

> This view is derived, I think, probably unconsciously, from a philosophical error: it has always been customary to suppose relational propositions less ultimate than class-propositions (or subject–predicate propositions, with which class-propositions are habitually confounded), and this has led to a desire to treat relations as a kind of classes.[51]

Let's consider a simple example: "Heidegger knows Bertrand Russell" or "I am taller than you"—it is impossible to think of these statements in terms of subject–predicate class-proposition (I and Russell cannot be reduced to a class-proposition; besides, both of us belong to the class "human being"), but there is still a need for an independent mathematical treatment of such statements. As Russell suggests, they could be expressed in the form *xRy,* in which *x* is understood as the *referent, y* as the *relatum,* and *R* as the *relata.*[52] In modern mathematics and computer science, the "relational calculus" has been further developed into two branches (with different modes of inquiry): tuple relational calculus[53] and domain relational calculus.[54] The Tuple Relational Calculus was introduced by the mathematician and information scientist Edgar F. Codd in the 1960s. It is part of the relational model, which in turn is the foundation of the relational database.

This relational technology is further realized by digitization and employed to develop unified systems. Later, in chapter 1, I show that the digital shouldn't be understood merely in terms of ones and zeros but rather as the capacity to process data. From the 1970s until the present, with the proliferation of personal computers and the development of the Internet and then the Web, we have seen informational technologies move from a specific group of experts into the hands of ordinary users. We have also witnessed the emergence and concretization of digital objects, from GML through SGML, HTML, XML, and XHTML, and today to the Web ontologies proposed in Tim Berners-Lee's vision of the semantic web. It is also the mysterious word *ontology* that makes the inquiry into digital objects strongly related to philosophical studies and allows us to see that the technical questions are fundamentally philosophical. To reiterate, the digital objects to be discussed in this book are data objects formalized by metadata and metadata schemes, which could be roughly understood as ontologies. Each object consists of multiple logical statements, as the opening of this introduction illustrated.

The emergence of the computer and the popularization of its use for massive data processing announced the arrival of information systems grounded on a relational view of beings. Edgar Todd's relational database is one of the milestones in this development, and the semantic web currently being proposed by the World Wide Web Consortium represents the updated status of the development of interobjective relations. As a bunch of logical statements, digital objects are subsumed under calculation. The affectivity and sensibility of the objects are calculable. A digital object's relation to other digital objects will increase through logical inferences, even though it has the same content. Networks are created among the digital objects being actualized according to certain parameters and algorithms. The multiple networks, which are connected together by protocols and standards, constitute what I call a *digital milieu*. Jacque Ellul was probably the first to notice this evolution and its relevance to data processing in the 1970s. In his book *The Technological System* (1977), Ellul took up Simondon's concept of objects and ensembles and developed his own view of technical systems:

> Data processing solves the problem. Thanks to the computer, there emerged a sort of internal systematics of the technological ensemble, expressing itself by, and operating on, the level of information. It is through reciprocal total and integrated information that the subsystems are coordinated. This is something that no man, no human group, no constitution was able to do. The further technicization advanced, the more the technological sectors tended to become independent, autonomous, and incoherent.

> Only the computer can deal with this. But it is quite obvious that it cannot be one computer. It has to be an ensemble of computers working interrelatedly at all communication points of the system. This ensemble becomes the subsystem of connections between the different technological subsystems.[55]

Humans are already integrated in a materialized network that submits to manipulation by algorithms, and they also have the capacity to do all these things by themselves. This gives us a new motivation to think of the technical system as no longer separated from the social and economic systems but rather as having the power to converge and integrate all as part of its functions. Simondon thought of concretization in a similar manner, but in the 1950s, it was still too early to anticipate the arrival of the network age. The network for Simondon was the limit of technical progress, because networks will come to dominate technical activities, while humans won't have the means to change them. The proliferation of the new industrial digital objects has changed this situation and thus motivated us to reconsider Simondon's opinion, which he expressed as follows:

> One changes tools and instruments, one can construct or repair a tool oneself, but one cannot change the network, one doesn't construct oneself a network: one can only tie in with the network, adapt to it, participate in it; network dominates and encloses *[enserrer]* the action of individual beings, dominates even every technical ensemble."[56]

If we can follow well the progress from object to system and materialization of relations, then we should ask the question, what do they imply? In what way can we approach these objects to further understand their existence? This remaining task is pursued in this book by interrogating the two types of relations that we have observed in the thoughts of Gilbert Simondon and Martin Heidegger and developing their value and insights for the understanding of the nature of data as objects.

Why do we approach the question of the existence of digital objects from the perspective of data? True, these objects appear to human users as colorful and visible beings, yet at the level of programming, they are text files; further down the operational system, they are binary codes, and finally, at the level of circuit boards, they are nothing but signals generated by

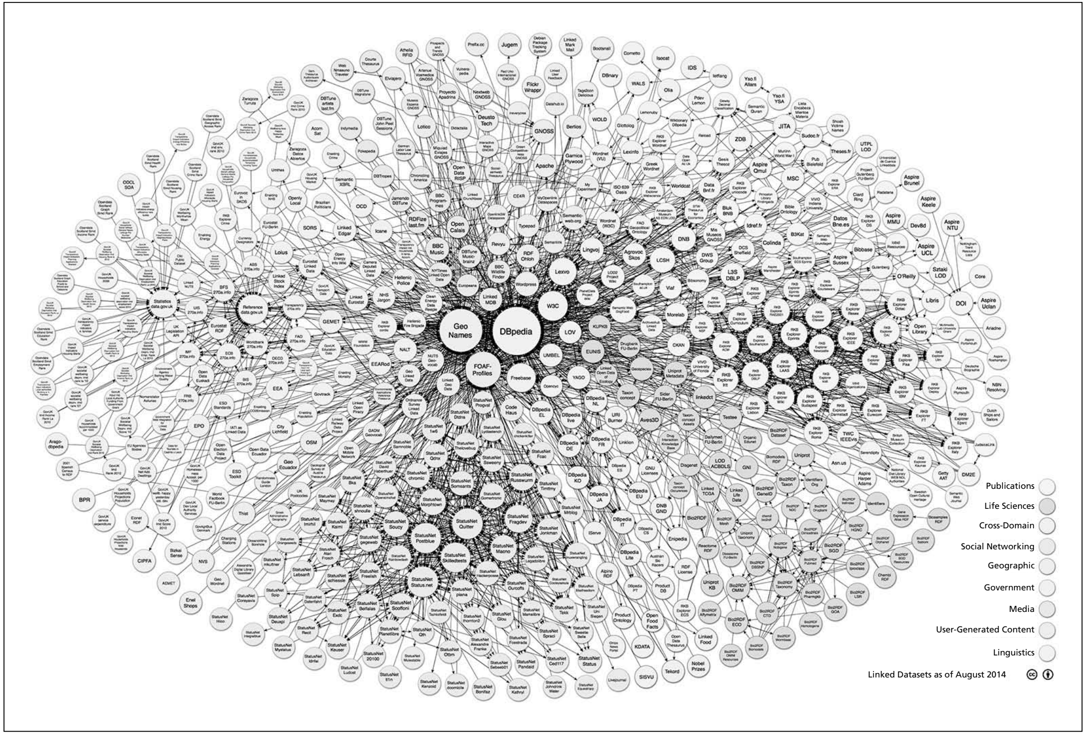

Figure 5. By formatting ontologies in RDF format, it is possible to reassemble all these ontologies by analyzing the semantics of compulsory vocabularies. Linking open data cloud diagram by Max Schmachtenberg, Christian Bizer, Anja Jentzsch, and Richard Cyganiak, 2004. http://lod-cloud.net/.

voltage values and the operations of logic gates. How might we think about these voltage differences as being the substance of a digital object? Searching downward, we may end up with the mediation of silicon and metal. And finally, we could go into particles and fields. It would be possible to approach from these different layers, but doing so may not be the most productive method. In the following section, I explain the methodology based on the analysis of orders of magnitude that will allow us to effectively position our inquiries and develop a unique philosophical method.

Existence

Method: Orders of Magnitude

My interpretation of the order of magnitude comes mainly from Gaston Bachelard and Gilbert Simondon. The order of magnitude has been a method well known in the epistemology of science. Simondon's approach seems to be influenced very much by Bachelard, though Simondon wanted to employ it for the analysis of technologies rather than science. This method of analysis, according to the orders of magnitude, is the central method of this book; however, the method of analysis also distinguishes itself from those of Bachelard and Simondon. For Bachelard, the order of magnitude is also a means of departing from the Cartesian subject of observation, which favors an absolute localization and permanent individuality.[57] The Cartesian subject sees from one perspective and one reality: the extension. The orders of magnitude allow us to observe different modes of existence of things. Bachelard defines the order of magnitude as follows:

> At the school of science, one learns to think in agreement with the order of magnitude of the phenomenon being studied. . . . This order of magnitude can be considered a first level of verification. In itself, it may often appear as sufficient proof. Not only does it justify a method, but as absurd as the atmosphere that surrounds it, it appears as the sign of an existence, a decisive mark of the ontological faith of the physician, and it is even more striking as the imprecision of the being outlined is larger.[58]

The order of magnitude also designates an approximation or imprecision, meaning that it is impossible to fully analyze the world with absolute precision; rather, one may do so only relatively. This isn't only a result of the influence of Heisenberg's principle of uncertainty but also because the orders of magnitude may give us different bodies of knowledge that appear to be *exclusive* to one other. A certain order of granularity is a selected reality. The level of abstraction is an engineering method whereby complexities are reduced into understandable terms: it starts from a problem and divides it according to different abstractions. The order of magnitude divides the question into different realities as mediated to the observer by instruments. To analyze the existence of the objects under observation, the observer needs instruments that are specific to an order of magnitude. For example, because of the wave–particle duality of light, we can reach different conclusions with different apparatuses of observation. This is the core idea of Bachelard's concept of *phenomenotechnics.* For each order of magnitude, we cannot penetrate fully into the object, but we should rather ask, what can we neglect?—for "that which we can neglect, we should neglect."[59]

For Simondon, the order of granularity is also a method that allows refined studies into the different modes of existence of technical objects, but also into the different layers of inventions. For example, we can approach them in terms of technicity, aesthetics, or perception. In *Du mode d'existence des objets techniques,* Simondon approaches technical objects through the progress of the concretization of causal relations and the population of technical knowledge; in *Imagination et invention,* he approaches them through images and imagination, looking at industrial products in terms of their external, middle, and internal layers: the external layer being a manifestation of the object in its outer world, the middle layer being semitechnic and semilinguistic, and the internal layer being purely technical.[60] A nuanced difference that we can observe between Simondon and Bachelard is that, for Simondon, the technical apparatus–instrument is not only the medium that allows us to observe different levels of depth of a phenomenon but also a tool that bridges two different orders of magnitude. This is also a second notable difference from Floridi's use of levels of abstraction, because a level of abstraction is an analytic tool, but not a synthetic one. As an illustration of what is meant by a synthetic tool, Simondon proposes that the alienation of industrialization arises from the synthesis of two orders, those of microtechnics and macrotechnics. For artisan objects, this mobilization and unification was not possible but only takes place with the appearance of industrial technical objects.[61]

In this role of mediation by the instrument, we may find a resolution amounting to a jump that traverses different orders of magnitude. In other words, the material construction acts as "information" that triggers the resolution of tensions between two different orders of magnitude and consequently changes the whole structure. The jump that accompanies it is also a restructuralization that we can call transduction, following Simondon. This also allows us to develop a general philosophical method that creates coherence between different orders of magnitude and systematically construct a plane of consistency (in Deleuze's terms). Kant's famous antinomies could be seen as attempts to set up two extreme orders of magnitude regarding the same object of inquiry. For example, in the first antinomy, we read the thesis "The world has a beginning in time and is also enclosed within bounds as regards space," followed by the antithesis "The world has no beginning and no bounds in space, but is infinite as regards both time and space."[62] We can see that the first order concerns physics and the second order concerns intuition. The resolution of these two extreme orders gives Kant a philosophical method and the motivation to systematically develop a coherent theory. Though Floridi also related his method to Kant's antinomies, here I want to place a greater emphasis on resolution.

Our method largely bases itself on this approach toward different orders of magnitude and aims to produce a system of thoughts that bridges different orders of magnitude through developing a theory of relations. Philosophical concepts can be seen as inventions that try to overcome the incompatibilities or even indifferences between two orders. Hence philosophy remains technical in this project. But a philosopher is different from a technician. Bachelard noted,

> Finally the engineer is not an artist who creates and signs a work full of personality, he is a geometer, guardian of rational methods, veritable representative of the technical society of his epoch. He is, like the physician, going down the narrow road of approximate realizations. He sees a precise end.[63]

Philosophers search for relativities such that this rationality is viewed not as an absolute method but as a relative method. On one hand, this destabilizes the rational method, but on the other hand, it connects it to another order of magnitude. In this book, we approach digital objects through different orders of magnitude. But this is by no means an attempt to construct a precise system of knowledge; rather, it seeks to set up a line of thought, incorporating both technical and philosophical thinking, that bridges the different realities of a digital object. What underlies this method of orders of magnitude is the understanding of relations—because relations can be extended from one system to another, from one order of magnitude to another. This also reflects the consistency between our method and philosophical thought. Relation is by no means monism; rather, it gives us an "immanent pluralism," and corresponding to this horizontal axis is the vertical axis of seeing, of *theoria.*[64] If technicians understand structure as the source of relations, then as Bachelard said, the "metaphysician would understand the best how the relations determine the structure."[65] The order of magnitude becomes a general method of this book. It also underscores the novelty of philosophical thoughts and suggests how far philosophical thinking can transcend a system that imprisons it through connecting the orders of magnitude already integral to the system.

Ontogenesis: Ontologies versus Ontology

There are different spectrums of orders of magnitude, which could make possible some original investigations. For example, we can approach from the first set of orders of magnitude: this would be the spectrum running from the order of microphysics to that of representation on-screen. A second set of orders of magnitude is presented by the technical specifications of the semantic web architecture. The third spectrum would run from code to phenomenon. We choose the third spectrum and approach from the perspective of data, because it is this that forms the intermediary between calculation and human experience. Hence it will be the order that allows us to address and analyze both the upper and lower levels of the existence of digital objects. A question that might be posed of the undertaking in this book is why it is concerned with the *existence* rather than *modes of existence,* the term used by Simondon as well as by Étienne Souriau (*Les différents modes d'existence,* 2009/2012), and also by Bruno Latour in his recent book *Enquête sur les modes d'existence* (2012). Indeed, for some readers, the different orders of magnitude or different levels of reality of digital objects that I seek to elucidate might seem synonymous with, or even better described by, the term *modes of existence.* However, I make this regression (in the best sense of this word) from *mode of existence* back to *existence* because I would like to develop a project that cares not only about the description of the modes of existence of digital objects but even more about their potentials and problematics. A project concerned with the existence of digital objects wants to rearticulate the positions of both objects and humans in the technical system in favor of an individuation proper to humans and objects. In other words, underlying this project is a political agenda of individuation.

Concerning existence, we can articulate two orders of magnitude: ontologies and Ontology. Ontology comes from the Greek words *on* and *logos. On* is the present participle of *einai,* meaning "to be." *Logos* comes from *legein,* meaning "to talk about," or as Heidegger says, "to lay down in front of." One of the central themes of this book (especially in chapter 2) will be the revealing of the tension between ontologies as used in computation and formal ontology and what Heidegger calls fundamental ontology (throughout the book, we use *Ontology* with a capital *O* to refer to the latter and *ontologies* to refer to the conceptualization used in information science). Ontologies, which we will see as lying at the core of the construction of the digital object, are criticized by Heidegger as a metaphysical oblivion of existence. For Heidegger, metaphysics has left the question of Being unquestioned, while only paying attention to ontologies. This forgetting, as a fault, also implies the problematic development of modern technologies, because modern technoscience, which, according to Heidegger, takes the world as a picture that one can grasp and describe in a controllable manner (ontologies), leads toward danger. Heidegger also suggested that a shift from technics to technologies took place in the eighteenth century, foregrounded by the beginning of modern physical science in the seventeenth century. This shift also implies a planetary project of development—modernization. The essence of technology is nothing technological but what he calls the Enframing *(Gestell). Gestell* comes from the verb *stellen,* meaning "to put," "to set something there." In this setting-there, nature, including the human, becomes the standing reserve *(Bestand).*[66] In our inquiry, we use the word *technical* more often than *technological* to denote a broader conception of technics as well as the possibility of the transformation of negative technologies into something favorable.

However, we still find ontologies to be the most important constituents of digital objects. Ontologies are what make digital objects objects rather than merely data. Ontologies are productive, like Kant's categories. Categories capture data and organize them in an order that unifies the manifold elements of their presence. Analogically, ontologies give a machine the ability to recognize and operate the object as a unity instead of as random data. In chapter 1, we will see two movements now taking place in parallel in the digital milieu around the question of objects. On one hand, we have the *objectification of data,* on the other, the *dataification of objects.* Ontologies are still going to be significant for this stage of the development of the Web and other applications. These ontologies also become the source of relations. That is to say, they are not merely representations. These relations multiply and intensify, especially when the objects are put in broader milieux. Information technologies, as we will see in chapters 3 and 4, can be understood as technologies of relations. This poses another question: if we are already in a technical system, how can we address the critique of Heidegger, and where will we find a place for the fundamental Ontology?

Ontologies and Ontology are understood in this book as two different orders of magnitude. These two terms demand a third term to resolve their tensions, which we will call, following Simondon, *ontogenesis,* while the third term that we have for the resolution of the tensions between being and Being is *relations.* Ontogenesis means the origination and development of an individual organism; it concerns less what an individual is and more how it individuates in itself and how it does so in the collective. For Simondon, between different orders, there exist a ground and forms. We can probably say that Ontology is the ground and ontologies are forms. Forms cannot exist on their own, because forms didn't create themselves, so that it is rather the ground that carries forms. But this doesn't mean that forms are opposite to ground, nor are forms less important than the ground. An example Simondon gives is that life is the ground and thoughts are forms. There wouldn't be a thinking being without life.[67] Simondon also found there to be an analogy between technical objects and living being. The forms of technical objects need a milieu that is an ensemble of other technical objects and the environment. Indeed, if we want to consider the technical system, and if we understand living beings—here humans—as part of the technical system, then this form and ground must be understood otherwise and here underlie the political agenda of a project concerned with existence.

Reticulation and Convergence

In the writing of Simondon, we can probably say that the mode of existence of a technical object is in its different modes of reticulation, which range from the internal structures organizing different technical elements, individuals, and ensembles to the wider milieu within which a technical object resides. For Simondon, the problem of alienation comes from a misunderstanding or lack of understanding of technologies, hence the misconstruction of a technical ensemble. And this misunderstanding leads to the rupture between ground and forms. Simondon identified that, first, alienation happens when the associated milieu can no longer regulate forms. Forms affect ground in that the ground is not able to maintain a recurrent causality with forms. This recurrent causality is the associated milieu. Second, the bifurcation of knowledge has produced a situation in which culture is detached from technics. In chapter 4, we revisit Simondon's speculative history of technics, where magic is depicted as having bifurcated into technical objects and religions, with technics then bifurcating further into science (theoretical) and technology (practical). For Simondon, it is necessary to develop philosophical thoughts that mitigate the opposition between culture and technics and invent a technological humanism against alienation. Philosophical thought has the task of creating convergences after bifurcations have taken place.

For our inquiry, the milieu that we are in is no longer an ensemble consisting of machines and operators, as Simondon perceived it in his time; it is rather an information system composed of multiple networks of objects and users. If alienation can be analyzed through the malfunctioning of the associated milieu, this means that social normativity can be analyzed technically, because it is already inscribed in the technical system. If we want to solve the problem of alienation due to industrialization, then the task will be to analyze the technical system, and this will demand a rigorous method. This book understands the technical system consisting of humans and objects as a unity of relations and proposes to think of the organizations of relations according to different orders. To approach a technical system, and to put its associated milieu in the right position, we should thus start from existential relations and then move to discursive relations to coordinate the ground and forms. This reading of Simondon and the problem of alienation is also influenced by Heidegger's critique of the essence of technology.

The agenda of convergence is also central in the thought of the late Heidegger, especially in his 1950 essay "The Thing," where he proposes to understand a thing in a fourfold manner, the four dimensions being God, heaven, earth, and the mortal. Heidegger observes that although it seems that technological development has greatly reduced the distance between things, for example, through television, radio, and telephone, in fact the distance between humans and things has only been enlarged. Heidegger proposes to go back to the meaning of the word *thing (Ding)* and its relation to the old German word *dinc,* meaning "to gather." The thing (the jar in Heidegger's example) in this case becomes a site that gathers the fourfolds. Users of social networks know that a digital object, for example, a Facebook image, serves the function of gathering comments and discussions from other users. Heidegger would have doubted such conception, just like he has questioned the telephone and the television. To follow Heidegger, the question that we want to pose here is, how can we deal with the question of convergence, when we are already able to create networks? As we have already noted, Simondon wasn't able to provide an answer to this question, because in his time, it was still impossible for an individual to create a network. Meanwhile, Heidegger's return to the fourfold nature of the thing as well as Simondon's understanding of networks present us the possibility of developing an interobjective thinking (as we explain in chapter 4), which could become an analytic tool for understanding the systemization of technologies.

The aim here is to go back to digital objects themselves and to think about other forms of convergences and reticulations in relation to experience. In particular, this is the task of Part III of this book. From Part I to Part II, there is a movement from objects to systems, from ontologies to Ontology, finally reaching resolution in relations and ontogenesis; subsequently, in Part III, there is a return to digital objects, but this time we confront the relation between logic and object, a different order of magnitude. For the ultimate aim in constructing digital objects is to implement a logical language traversing the Web. At the beginning of the twentieth century, Husserl already saw the problem of formal logic as one of the manifestations of the crisis of European science. Husserl understood formal logic as a technicization *(Technisierung),* through which we become no longer able to understand the origin of logic, which is experience. For Husserl, we can find a stronger notion of judgment in experience rather than symbolic logic. In contrast, he proposed an intentional logic (as opposed to extensional logic) to reestablish the foundation of logic. Today there is still much discussion of Husserl and formal ontology among analytic philosophers, but Husserl's strong proposal to overcome formal logic is seldom discussed. Nonetheless, one can ask, as this book does, can this Husserlian imperative be retrieved and rendered practical in thinking about digital objects? This doesn't necessarily mean that we would have to give up formal logic; rather, we'd have to realize the Husserlian concept on a computational level, as Brian Cantwell Smith has brilliantly done.

Heidegger's critique went much further than Husserl's. The technization of the world is the manifestation of a metaphysical mistake. In what Heidegger calls the essence of technologies, *Enframing,* forms come to the fore and become the force of industrialization. In this process, time only serves as the synchronization of forms. For example, people tend more and more to rely on machines to organize their lives and give to mobile phones the responsibility for synchronizing their meetings, eating, sleeping, and so on. In this synchronization, there is a destruction of the unity of time, which Heidegger calls *care.* Everyday distraction will be amplified by technological development. This is not only the problem of the manifestation of technology but is, at bottom, the problem of thinking, a thinking that privileges forms: logic. Logic poses a question to thinking, because logic moves from one concept to another according to rigid relations. The invention of cybernetics, as Heidegger saw, is the logicization of language. Language once understood as disclosure loses its temporal ecstasy. Its function as a revelation of being starts to disappear. Language is deprived of its ground by its forms. Philosophers also cease to think: as Heidegger said, "one no longer thinks; one occupies oneself with philosophy."[68] Heidegger, in *Kant and the Problem of Metaphysics,* wanted to retrieve the foundation of metaphysics through the notion of transcendental imagination as the faculty of transcendental apprehension—whereas in edition B of the *Critique of Pure Reason,* Kant had removed this role for the transcendental imagination and made it just one of the functions, instead assigning the power to schematism, that is, to the categories and logic. Heidegger wanted to reread Kant as a critique of neo-Kantians and positivists, who believe that logic should be made the ground of metaphysics. For Heidegger, metaphysics is completed by cybernetics: we live at the end of time.

Now if the information system, the semantic web in particular, is striving for a language of logic, what is meant by this? When everything is becoming data and being represented in logical statements, and then automated by algorithms, isn't this a higher mode of *Enframing*? This presents an impasse to either arguing for Heidegger or against him. We could understand these differences in terms of orders of magnitude. If time is the foundation of metaphysics, then couldn't even technics be understood as time? This is also the concern of Bernard Stiegler, who has proposed to understand technics in terms of time or, more precisely, tertiary retention. Much of this book is influenced by Stiegler's perspective, which served as the inspiration to think about time in a technical system. Indeed, we can identify different orders of magnitude of time in a technical system: point-based clock time, intervals and periods, topological time, which we discuss in detail in chapter 4. Based on Stiegler's tertiary retention, we can also identify a tertiary protention made possible by algorithms. In fact, thanks to these tensions set up by Husserl and Heidegger, we are able to rethink logic and digital objects. We can ask whether logic is only one set of these relations, in which case, should we not be able to think new types of relations and new ways to organize relations? Could a Husserlian critique and organization of digital objects be possible? Can we find a transductive logic in a technical system that may point us to new forms of individuation (of objects and of *Dasein*)?

How, then, is a relational thinking, already realized in technics, able to negate itself, to redirect itself toward another possibility? Isn't this what Heidegger said about the danger of technology when he quoted the poem of Hölderlin?

Wo aber Gefahr ist, wächst
Das Rettende auch

But where danger is, grows
The saving power also[69]

We have seen that a similar logic was explored by Lyotard in his project of the postmodern as well as in the critique of the substance–accident conception of objects. The new possibilities lie in the grasp of a rigorous way of thinking and a sensibility toward technological development. Hence the analysis of the genesis of digital objects in terms of relations, and an appreciation of the reality of technical progress as the evolution of interobjectivities, attempts to discover a new sensibility for being with objects enabled by technologies; and it is there that one may find the possibility of a transformation through the reevaluation of the associated milieux in both philosophical and technical terms.

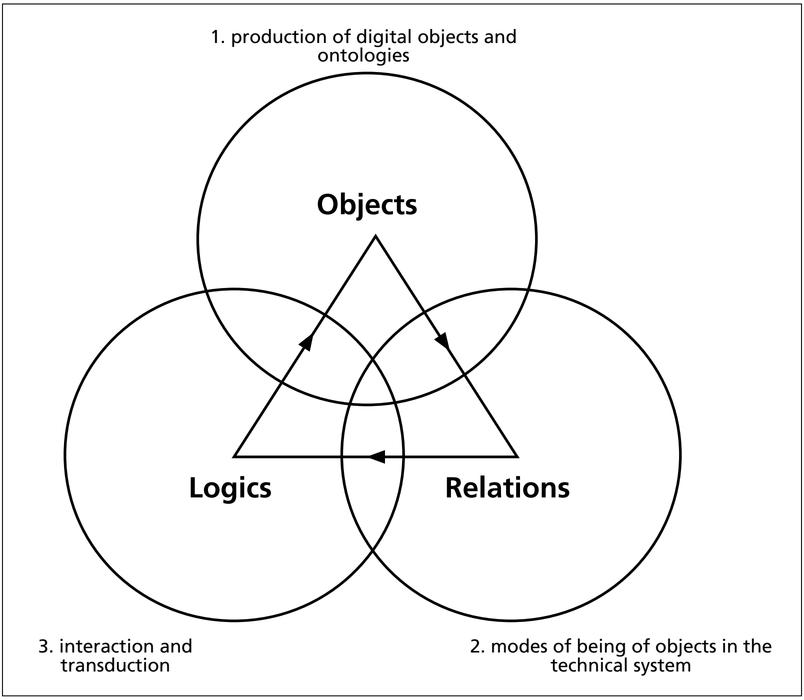

Figure 6. The mapping of three parts of an investigation into the life cycle of digital objects.

Structure of the Book

This book aims to develop a philosophical investigation of digital objects by studying the development of markup languages and ontologies through Heidegger's and Simondon's theories of objects. Situating itself among different contemporary theories, such as object-oriented philosophy (and even speculative realism), philosophy of information, and digital philosophy, this book aims to provide a relational thinking for the study of objects and also to translate it into critical questions for the design of technical artifacts. Though this may seem an ambitious project, it should be considered a contribution to a greater framework of the study of the digital in the future, which will demand more and more synthesis between theory and practice. To carry out this study, I have mapped the life cycle of digital objects, as shown in Figure 6. The book is divided into three parts: Part I, "Objects," Part II, "Relations," and Part III, "Logics." Each part consists of two chapters.

Chapter 1 outlines the genesis of digital objects by looking at the history of markup languages, from GML to HTML, XML and the Web ontologies proposed by the semantic web movement. This chapter reads this technical history in parallel with Simondon's analysis of technical objects, that is, by seeing it as a process of concretization and individualization. Individualization is presented as a method for analyzing the evolution of the internal dynamics of technical objects rather than understanding them in terms of social–economic constructions. The chapter further asks if it is also possible to understand the individuation of digital objects. This question wants to push the inquiry further because Simondon didn't use the word *individuation* for technical objects, whereas I propose that thinking through the individuation of technical objects is a way to render explicit Simondon's project on technical objects, which starts with a discourse against alienation. This imperative from Simondon is present throughout this book, and the notion of individuation as well as that of transduction will be picked up from time to time.

Chapter 2 starts by setting up two oppositions: (1) ontologies versus Ontology and (2) semantics versus syntax. It surveys different notions of ontologies and objects in computation, through the work of Tom Gruber and the research on formal ontology by Barry Smith, Nicola Guarino, Boris Hennig, and so on. Formal ontology is a concept proposed by Edmund Husserl in his *Logical Investigation* and later in *Formal and Transcendental Logic* and is further taken up by contemporary philosophers who work on information systems. Recognizing that this reference to Husserl in fact ignores the fundamental aim of Husserl's project, which is a phenomenological approach to logic, this chapter proposes to look at the notion of object and ontology from a fresh perspective. The chapter singles out the work of the computer and cognitive scientist Brian Cantwell Smith, whose book *On the Origin of Objects* consisted of a strong critique of the dogmatic approach of computer scientists toward ontologies and a proposal for a foundational metaphysics for computation. We will then find that in fact, Cantwell Smith's approach is very close to Husserl's, especially those aspects of the latter that have been ignored by formal ontologists. The chapter then introduces another conception of ontology, Heidegger's fundamental ontology, or Ontology. This chapter ends by suggesting that these oppositions may be resolved through a third term, that is, by (a theory of) relations.

Part II aims to develop a materialist theory of relations. Chapter 3 sketches such a theory through a reading of the concept of relation in the history of philosophy, especially in the work of Aristotle, Leibniz, Hume, Heidegger, and Bertrand Russell. It suggests that we can understand relations in two forms, as discursive relations and as existential relations. This chapter further illustrates how discursive relations are implemented in computation, first through relational calculus, then through the relational database proposed by Edgar Codd, and finally in the current development of the semantic web. It suggests that to understand the individuation of digital objects, it is necessary to overcome the tension between discourse relations and existential relations, and that the resolution of this tension leads to a discourse of a technical system.

Chapter 4 continues by taking up the notion of the technical system, which centers on the concept of interobjectivity. Phenomenological research, as well as the phenomenological sociology of Alfred Schutz, has placed the focus on intersubjectivity, without paying much attention to interobjectivity. By interobjectivity, I mean relations that can be materialized as discursive relations, for example, physical contacts in mechanics, formal logic, and so on. The suggestion is that the concept of interobjectivity instead of intersubjectivity can be further developed to understand the evolution of technics. Specifically, I look at the emergence of information systems, the Web, and the discourse on technical systems of Jacque Ellul (who was inspired by Simondon) and historian Bertrand Gille, showing that the notion of milieu has been slowly replaced by the notion of system.

The chapter proposes to read Heidegger's 1950 essay *Das Ding* as a proposal to reconstruct interobjectivities, which he calls the fourfolds *(das Geviert),* to bring human and world together in light of the supposed fact that technologies (TV, radio, telephone) have shortened the distance between humans. It also looks at the speculative history of Simondon, which understands the history of technics as a process of bifurcation from magic, subsequently followed by constant bifurcation, and his proposal for mobilizing philosophical thinking to create a convergence, one that would reunite man and world. Common to both of them is the advocation that we go back to things (Heidegger) and technical objects (Simondon) to produce a convergence between humans and world. This idea might immediately give rise to the objection that we surely already live in a networked society, in which the distances between things and humans are diminishing, especially in light of a dominant trend in social sciences that sees objects as acquiring new degrees of agency in contemporary culture.

However, as Heidegger argued, these networks are not really producing convergence but rather distances.

If we want to think within the technical reality of systems, then in what ways can one further develop the notion of digital objects? Though Simondon cannot give us a direct answer, his efforts to think about the development of technical objects and to conceive a technological humanism remain central to Part III, which takes up this question with a direction of inquiry that takes a sharp turn from that of the previous chapters. If the previous chapters aim at developing a speculative philosophy of digital objects, the last two chapters deal with human experience and metaphysics, which I believe are fundamental to Heidegger's and Simondon's discourses on modern technologies. Hence Part III, as the reader will see, sets out alternative histories of logic, which are also seen as the foundation of digital objects as well as computation. These two chapters revisit the debates around logic that took place at the beginning of the twentieth century, notably in the works of Husserl and Heidegger, to suggest another way of looking at convergence by thinking about digital objects differently.

Chapter 5 considers some recent debates (Patrick Hayles and Tim Berners-Lee) on logic, especially concerning meaning and reference on the Web, employing the theories of Frege, Putnam, Kripke, and Davidson; it proposes an alternative way to understand this issue by revisiting Husserl's critique of logic (which is rarely mentioned today among computer scientists and computational theorists, who employ his formal ontologies) and Simondon's transductive logic. This debate could be characterized as the pitting of an intentional logic against an extensional logic, a transductive logic against classical logic. The former operates on intentional acts and horizons of meaning; the latter operates on symbols and rules. This chapter aims to propose that it is possible to develop further the critique of Husserl by its application to the Web, to produce a new convergence that is at the same time cognitive and collective. We can further ask the question, to what kind of convergence should this lead? Certainly this would be something along the lines of the collective intelligence proposed by Pierre Lévy or, more precisely, the symbiosis prefigured by Lickleider or the autopoiesis proposed by Varela and Maturana. But can we consider this as simultaneously a progression in both technology and the humanities? In parallel, the reader can also read it as an attempt to reinvent Husserl's phenomenological method by undermining the pure ego as well as a reconciliation between Husserl and Simondon in the spirit of Deleuze.

Chapter 6 problematizes this "collective intelligence" by going back to the debate between Heidegger and the neo-Kantians on logic, because this debate concerns the foundation of metaphysics. Heidegger thinks that when, in the second edition of *Critique of Pure Reason,* Kant deleted the section on transcendental imagination, he was taking a step backward, shrinking away from something crucial. Heidegger's task was to show that transcendental imagination thus understood as time instead of logic should be the foundation of metaphysics. The chapter reconciles this debate by proposing the concept of *tertiary protentions* as a new synthesis of time that comes out of a reading of Husserl, Stiegler, and Deleuze. The discussion of tertiary protentions leads to an investigation of the algorithm and the milieux of digital objects. What exactly is an algorithm? A conventional example is that it functions like a recipe. I propose that, instead, one should approach it from the concept of recursion, by tracing the history of mathematics of Dedekind, Skolem, Gödel, and Turing, which allow us to think of a machine hermeneutics. The intensification of the algorithm in the process of thinking leads to the problem of the destruction of the associated milieu as described by Simondon, whereby the internal dynamics of the technical object cannot be maintained. This chapter ends by suggesting a return to reflection on the construction of the associated milieux beyond technical systems.

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· Part I ·

Objects

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· CHAPTER 1 ·

The Genesis of Digital Objects

Digital Objects and Their Milieux

We are currently living in a digital milieu; we Facebook, we blog, we Flickr, we YouTube, and we Vimeo. Nouns and brands have become verbs, even forms of life. The speed of technological innovation, the ubiquity of the latest and greatest versions of electronic devices, the promise of an emancipative technology or media, financial investment based on the digitization of human relations, and so on—they all constitute a seeing that is never in the present but is rather the projection of a nihilistic not-yet. This mode of existence is not what Martin Heidegger calls "temporal ecstasy," in which one nonetheless grounds oneself in an authentic time; it is rather a hyper-ecstasy that celebrates speed while simultaneously being haunted by the anxiety of not being there, not being able to situate itself within the grand rhetoric of the technology evangelists. I call this experience *technological ecstasy,* a way of becoming that has no clear idea of its direction yet is characterized by acceleration and adventure. The constant passing of the "new" constitutes an *indifference toward rhythm,* which, in turn, legitimatizes a natural seeing of what is there and what is expected. The word *new* denotes the passing away of the old and the differentiation of the world in its projection, driven by a gigantic force of movement.

The understanding of technology is no longer a matter of a cultural critique of technology. Indeed, the traditional exclusion of technology from culture must be brought into question. To resolve this conflict we must employ a new *organon,* or a new series of philosophical propositions. Any proposed theory would initially need to identify the reality with which it is concerned. To understand the "real," we must compare it with what is commonly understood as virtual. The idea of the virtual, which was popular some years ago as a descriptor of certain kinds of community and interaction dependent on digital media, such as online forums and cybersex, has since receded into the background, as you can no longer say today that someone using Facebook or Second Life is living within a virtual world (considering that he is interacting with his real friends and engaging in activities like providing his credit card number and personal information to order a Swedish Visa online).[1] The introduction and convergence of technologies like Bluetooth, Wi-Fi, and GPS allow for more accurate contextual and geographical detections, leading us into the REAL. How can we address this digital milieu? It is another world, a strange world, one that is simultaneously artificial and natural. It is as complicated as what we used to refer to as the "real world," and more important, it is a world we are already *in*.

Our investigation will focus on digital objects to better understand where the current transformation process is heading and to develop an appropriate method for its investigation. The term *digital object* remains ambiguous here, because the vast quantity of digital objects are comparable in breadth and diversity to the vast array of animal species. Instead of addressing all of them, I will be focusing mainly on data and metadata, which embody the objects with which we are interacting, and with which machines are simultaneously operating. The first questions we will ask at this point are, does hardware count? What about algorithms? Although I am tempted to include all objects related to computation as digital objects, some restriction of scope is necessary to allow me to focus an equal amount of attention on the digital aspect of the digital object. We have a tendency to call everything an object, to generalize all computational components as digital objects. However, this approach appears to be rather problematic, because individual objects would lose their singularities. The same issue applies when object-oriented philosophers give the general name of "objects" to all entities apart from the human being. Thus it is necessary here to *suspend* any common understandings or interpretations of "objects." It is true that we are able to reduce all operations to 0 and 1 binaries, and even further down to the activities of electrons and atoms; however, this only gives us a particular order of reality in terms of what *digital* means, and one that has little to do with the direct experience of the users. Digital, in the context of this book, has a specific orientation toward the automation of data processing. Data directly intervenes throughout our human experiences in a double sense. When we look at the term *data*, we generally do not recognize its Latin origin, as the plural form of *datum*, meaning "[a thing] given." The French word for data, *donnée* ("given," from *donner*, "to give"), retains the Latin sense exactly. If data are the "things" given, then what is it that gives data? Aside from having the speculation in mind that this givenness comes from God, we should recognize that since 1946, the word *data* has had an additional meaning: "transmittable and storable computer information."[2] This second understanding of *data* suggests the need for a reconsideration of the philosophy of objects, because it can no longer be assumed to refer entirely to sense and noetic data. Instead, one should recognize this translation as taking on a material form and consider how this materiality constitutes a new form of "givenness." The significance of the recent development of data processing, that which we have since proclaimed as the digital, demonstrates the extension of data—exchanging capabilities beyond individual computers such that we can process large amounts of data by establishing connections to form data networks that extend from platforms to platforms, and from databases to databases, constituting a technical system.

The next question we face is, how should digital objects be conceptualized? According to the common view of scientists and/or mathematicians, we can have a superset of objects, inside which we can find a subset of objects called technical objects alongside natural objects, as theorized by Gilbert Simondon. It is also understood that within this subset, we can find a further subset of objects called digital objects. It is possible that there may be more subsets than those which have previously been accounted for, according to different schemes of classification. Instead of following this classification, however, I would like to propose a splitting between technical objects and digital objects. Digital objects are new forms of industrial objects. If the "new" demands a new understanding, then addressing this may begin with asking where this "new" came from. The new can only manifest relative to the old, either as a continuation or as a break or rupture. As Simondon would say, inventions always attempt to remove the obstacles and resume a general continuity of development.[3] The analyses throughout this book will be primarily concerned with a series of incompatibilities created by the reverberations of the new, those that demand we direct our attention toward the genesis of objects within a historical perspective. In this chapter, I describe the genesis of digital objects by situating them within the history of computing and introduce the analysis of Gilbert Simondon. I compare the relation between data and objects in the new setting and how this account of their genesis can contribute to our understanding of computational technologies.

The Double Movement of Object and Data

The methods through which objects become translated into data are not new. They follow the logic of digitization after the emergence of the modern computational machines, namely, everything can virtually be represented in digital formats. There are two dominant forms of digitization: the first follows the system of mapping or mimesis (for example, the production of digital images, digital video, etc., which are visually and repetitively distributed throughout the physical world), whereas the second takes place by means of attaching tags to objects and coding them into the digital milieu (by means of this digital extension, the object then obtains an identity with a unique code and/or set of references). The second movement of objectification of data comes a bit later. I call the first process the *objectification of data* and the second process the *dataification of objects.* In saying this, I don't mean to say that these things are not objects before they are objectified by metadata schemes but rather that they are formalized as objects through human agency and then recognized as objects by computers; or, in the spirit of Heidegger, they are things *(Ding)* before they become objects *(Gegenstand).* This way of representing objects is widely known as knowledge representation. *Knowledge representation* has been a key topic within artificial intelligence (AI) for decades, and it is steadily increasing in importance again following the failure of a number of large-scale projects[4] now under the name "semantic web." This objectification process has two very significant implications: (1) it breaks away from the *hyperlink-based* Web to become the *object-based* Web and (2) it signifies a more significant role for the machine, not as an input–output device, but also as a partially "thinking machine." I want to approach this development in terms of two technical questions, which are simultaneously philosophical questions: the question of objectification and the question of intentionality and experience pertaining to thinking machines. Indeed, this book is the result of an endeavor to read the history of philosophy through digital objects and at the same time to read the history of digital objects through philosophy. Finally, we will see that computation is no less philosophical than philosophy, and philosophy is no less technological. To pursue this path, we need to unfold the technical details of the emergence of digital objects before proceeding to a more philosophically oriented analysis.

My reading of the movement of the Web sees it as the inauguration of a process of the objectification of data, not only for humans but also for machines. It is in this sense that the founder of the Web, Tim Berners-Lee, could envisage the emergence of a "global mind" shared between humans and machines and supported by the Web.[5] In 1989, when he proposed the World Wide Web at CERN (the Swiss-based high-energy physics lab), his model was largely influenced by the technology visionary Ted Nelson, although with some fundamental differences. For Nelson, the concept of a digital object was impossible, as he saw the network from the point of view of literature. Nelson's idea of hypertext was to realize nonsequential writing[6] through which the interconnectivity of literature can be unfolded in different temporalities. Every hypertext would imply a jump from one spatiotemporal setting to another, while through these trajectories, a network can be understood as a form of nonsequential writing.

Nelson's vision was restricted by its dependence on the limited concept of text and writing, whereas Berners-Lee's focus on the Web in the 1990s was primarily concerned with hypertext and the hyperlink. The striking difference between Berners-Lee's model and Nelson's model reflects their fundamental motivations. Nelson's vision of the Web was tied to a payment system, so that the payment to the authors of the literature could be managed by links. This motivation coincidentally led to a completely different architecture of links from that of Berners-Lee's model. Nelson proposed, in his Xanadu project, a two-way link system, while we know that the early Web was a one-way-link-based system on <a href>, which specifies the URL to be loaded when the link is clicked. Today these two-way links have been realized, not as Web architecture, but as overlays, such as blog comments, trackbacks, and so on. Berners-Lee's vision comes from the internal sharing of documents within CERN, so that different versions of documents could be linked and archived in a way that would minimize the loss of information in a "final report." Nelson was to some extent justified when he criticized the Web as a file system with one-way links: "today's one-way hypertext—the World Wide Web—is far too shallow. The Xanadu project foresaw world-wide hypertext and has always endeavored to create a much deeper system. The Web, however, took over with a very shallow structure."[7] But it is not an entirely fair comment, because we must also understand that for Berners-Lee, the Web in its evolution has already far surpassed this stage of file sharing.

For the Berners-Lee of the 2000s, the vision of the Web has already developed beyond the sharing of documents to the collaborative imagination of minds and machines. This is more or less based on the assumption that the mind perceives objects through representations. Structured metadata provide the computer program with the conceptualization of objects. The formal definition of metadata is "data about data." An intuitive example is the library search: when a person looks for a book in the library catalog, she must submit different information, for example, the name of the author, the title of the book, or the ISBN number. This information, which is in addition to the content itself (data), is known as metadata. The formats within which these data are presented are called *metadata schemes.* We can compare this with Kant's schemata, as the fusion of the pure concepts or categories that gives rise to phenomena from sense—data. In the age of hypertext, online objects are only meaningful to humans, not to machines. However, in the age of metadata, online objects are considered to be meaningful to both machines and humans.[8] Machines understand the semantic meaning of objects via the structures given to the metadata. This objectification movement is called the semantic web, introduced by Tim Berners-Lee in 2001. Berners-Lee argued that "in the future, when the metadata languages and engines are more developed, it should also form a strong basis for a web of machine understandable information about anything: about the people, things, concepts and ideas."[9]

The double movement from object to data, and from data to object, will be an ongoing project that will continue to develop over the coming decades. It presents us with new forms of objects, constituting a new milieu in need of further reflection. This is the case not only within the Web industry but also throughout information science as a whole. If we reflect on the early stages of the development of the catalog system within library science, we can see that it followed the same technological tendencies. The Web (or simply the Internet in general) promotes a milieu that includes various sectors influenced by a combination of technological, economic, and political concerns. For example, in library science, early cataloging schemes like Machine Readable Cataloging (MARC) and Angelo-America Cataloging Rules (AACR) grounded a lengthy effort to address the question of annotation. However, since digitalization and Internetization, these schemes have become obsolete and are being replaced by ontologies, such as Dublin Core (DC).[10] The reason for this is twofold: first, MARC and AACR are specific protocols that cannot be used outside of their limited field, implying that they cannot effectively be integrated into the digital milieu alongside other machines. The second reason is that they cannot be read by humans and are thus unable to

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245 10 Rhkjsow fijkslw bf ksjk jsiousol/$c w Hfuyse can Lqzx
250 2c pj.
260 0 Klana:$b Fry Psgh, $c 2001.
300 232p.; $c 28 cm.
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Figure 7. Information for a book in the MARC format.

participate in the universal communication of the "global mind." In other words, they do not treat a book as an object as such but rather as mere symbolic data. Figure 7, an example of MARC, provides the informational data for a given book.

"MARC must die"[11] is a familiar slogan commonly expressed among library technicians since the early 2000s (a website created by digital librarians is dedicated specifically to this cause). This has also presented a crisis regarding the creation of digital objects. Because librarians and technicians working with digital objects must manage a great magnitude of symbols that provide them with hardly any concrete or understandable information, they are condemned to be the assistants of machines. This has led to one of the most notable phenomena of alienation within the digital milieu. The vision of the semantic web, as a means of generating new forms of objects that are meaningful to both humans and machines, received a lot of appreciation and interest from various communities. The genesis of digital objects is hence not the sole effort of Tim Berners-Lee and his team in the World Wide Web Consortium but rather a milestone achieved via the advancement and development of the computation as a result of its long history.

Throughout the following sections, we examine the historical emergence of digital objects by attending to the thoughts and arguments of Gilbert Simondon. The importance of introducing Simondon's thought here in this context is that he was not only perhaps the first thinker to propose a philosophical understanding of technical objects but he also conceived the development of a technological culture to serve as a solution to Marx's critique of alienation. At the very beginning of *Du mode d'existence des objets techniques,* Simondon wrote, "The stronger cause of alienation in the contemporary world resides in this misunderstanding *(méconnaissance)* of machine, which is not an alienation caused by machines, but the lack of understanding *(non-connaissance)* of its nature and its essence, because of its absence from the world of significations and its omission in the table of values and concepts belonging to culture."[12] Simondon introduced a potential approach called *mechanology,* which would put machines at the forefront of general education, proposing that technological knowledge should be introduced as part of the educational curriculum, with a status equivalent to that of literature.[13] Throughout the history of metaphysics (which in Heideggerian terms equates to the history of philosophy), from as early as Plato to the later theories of Edmund Husserl, a technical object was nothing more than a tree in the garden or an apple on the table. What interested philosophers was either the idea of and the essence of the objects, as manifest in Plato's *idea,* Aristotle's *form and matter,* Descartes's *extension,* Leibniz's *monads,* Kant's *schematization,* Hegel's *dialectics of consciousness,* or Husserl's *noetic and noematic* correlation, or a natural (or organic) and mechanical opposition was posed, which consequently subordinates the mechanical to the natural. Technological knowledge simply did not achieve a formal position within this philosophical tradition, except at the brief moment of Diderot and D'Alembert's encyclopedia, which attempted to render technical knowledge transparent to the public. The emergence of cybernetics in the early twentieth century, however, stimulated a rupturing of the philosophical tradition by questioning the border between the natural and the artificial. The dynamic of machines cannot be captured solely by an *eidos.* This coincidentally created a demand for a new direction in philosophical thinking during the mid-twentieth century, from which emerged the two very contrasting approaches that are of particular interest to us here. On one hand, Martin Heidegger lamented that cybernetics marked the overall completion of metaphysics and simultaneously the end of philosophy. This caused him to attempt a retrieval qua retreat to a new form of thinking. On the other hand, Gilbert Simondon wanted to understand technology not as a closure but rather as a process working toward the perfection of technical individuals and through a systematic understanding of the transformation of the human with the evolution of tools to search for a technical disalienation.

Individualization of Technical Objects

We should first address two prominent concepts used by Simondon that are often confusing for his readers: individuation and individualization. For Simondon, individuation is clearly different from individualization. Individualization concerns functions such as somatic specializations and psychic schematization. When the term is applied to living beings, it denotes the development and division between the psychic and the soma. Individuation, alternatively, concerns the genesis and resolution of tensions to arrive at a metastable equilibrium passing by a restructuralization of relations.[14] Individualization is not opposed at all to individuation; they would be better viewed as two separate orders of magnitude of beings. In *L'individuation à la lumière des notions de forme et d'information* (2005), Simondon talked about the individuation of physical beings (e.g., crystals), living beings, and the individuation of psychic beings; in *Du mode d'existence des objets techniques,* he mainly talked about "technical individualization" rather than "technical individuation." Could we also discuss the "individuation of the digital object"? Simondon's hesitations toward this leave us with a rather large space of inquiry, allowing us to develop his efforts further. To expose these possibilities, it will be necessary for us to observe and analyze how Simondon carried out his analysis of technical objects.

A technical object is always a product of determination, or even overdetermination. The term *overdetermination* refers to a process of imposing constraints and conditions so as to maturate the functionalities of the technical objects. The maturity of technical objects can then be measured by what Simondon calls *technicity,* which is the degree of concretization within the object. Simondon sees the evolution of technical objects as a progression from abstract objects to concrete objects. To be concrete entails the convergence and adaptation of the object to itself. For example, when a technical object integrates further functions into itself and subsequently compromises these functions in a coherent way, it becomes more concrete than it was previously; as Simondon wrote, "the unity of technical object, its individuality, its specificity, are the characters of consistence and convergence of its genesis."[15] Hence we can say that industrial technical objects are more concrete than the artisan's products. Simondon argued that the customized products belonging to the artisans are not technically essential but that rather they are produced by other essential factors, such as external needs—whereas in industry, technical objects gain their own coherence. Simondon's technical objects are therefore also industrial objects.

According to Simondon's classification, there are two forms of technical object, namely, "element" (or "infra-individual") and "technical individual."[16] In comparison with the elements that are simply building blocks, the technical individual has a complete set of functions as well as a mechanism that allows it to maintain the internal stability in response to specific external disturbances. Simondon defines a technical individual as "one having an associated milieu as a *sine qua non* condition of its functioning." The associated milieu is a means of adaptation, ensuring that the individual is "not to be influenced by the external technical and natural environment."[17] This criterion implies that the object already has the ability to independently stand on its own within the constraints that are already set into its overdetermination.[18] Technical individualization for Simondon depends on the discovery and invention of its associated milieux:

> The principle of individualization of technical objects in an ensemble is therefore the principle of the sub-ensembles of recurrent causality in the associated milieu; all the technical objects that have a recurrent causality should be separated one from the others and connected in a way to maintain this independence of their associated milieux.[19]

We should note here that it is necessary to keep the associated milieux separated; otherwise, the unified associated milieu would become the Achilles' heel. Simondon's technical individual in this instance specifically refers to a hardware system rather than to digital objects, which consist mainly of code. At first glance, we cannot reuse Simondon's vocabulary to understand digital objects, because there is no such reciprocal causal mechanism inside the digital object that allows for its self-stabilization.[20] Alternatively, however, we can see that databases, algorithms, and network protocols become the associated milieux of digital objects. And as a digital object is also a set of logical statements, its reciprocal causality is highly controllable. The associated milieu cannot be thought of only as a mechanism inside the individual but should instead be considered as something in between the exterior and interior milieux. When Simondon discusses nonindustrial civilization as a time when humans do not have industrial technical individuals (because they only use simple tools), he says that man's "apprenticeship leads him to technical self-individualization. He becomes the associated milieu of the different tools he uses."[21] Humans created the associated milieu for the tools through their gestures and habits, stabilizing and regulating the entire ensemble: tool—bearers themselves became technical individuals.

In this sense, we are able to identify the associated milieux for digital objects, each of which is further stabilized by the specific network in which it is situated, additionally including its users, data structure, network protocols, and so on. To be stabilized by the system, it must also include various mechanisms that regulate it. The evolution and concretization of these mechanisms allow a digital object to develop and integrate an associated milieu of its own, which is what Simondon calls a technical *individualization,* whereby something corresponds to what was illustrated before as the "objectification of data" or schematization. This process of individualization consists of three parts. First is the synthesis of data through the metadata scheme, which is comparable to Kant's concept of the apprehension of objects. Second are the built-in constraints within the object, giving digital objects the capacity to regulate their identity within the digital milieu. For example, when considering an ontology of kinship, one can only have one mother and one father. And third, the object has now become a logical entity, hence it expresses a logical infrastructure as a constituent of the digital milieu. I will further demonstrate these three stages of the process in the following sections of this chapter. To push this still further, a digital object is also constantly in the process of reestablishing and renegotiating its relations with other objects, systems, and users within their associated milieux. Digital objects also take up the functions of maintaining emotions, atmospheres, collectivities, memories, and so on. This gives us a dynamic and energetic understanding of digital objects. I want to distinguish this process as *individuation.*

As part of an industrialized civilization, human beings have begun to lose their role as technical individuals, as they become mere operators, either pushing a button, moving raw material, or cleaning the machine. This does not necessarily mean that the human's position in the associated milieu will become any less important than it already is, or that humans will inevitably be ejected from the milieu as a whole. It is rather more likely that they will slowly become deskilled, and their technical knowledge, which indicates their affinity to machines, will be reduced to the most superficial level. This, for Simondon, is the problem of alienation raised by Marx. Simondon compared the relation between technical objects and the human as the relation between the musician and the conductor, as each produces an affect and is mutually affected by the other.[22] As with technical alienation, however, this mutual relation is destroyed. For Simondon, restoring this mutual relationship would be a means for developing a technological culture. Does the current technological transformation offer us the possibility of doing this? On a social networking website, digital objects are not able to function on their own without the activities of human beings, who create and modify them. Without this intervening creation and modification, machines would have nothing to process. The new demands that are placed on humans do not mean that they regain their importance, however. As we will soon see, a change occurs within nature regarding man's existence and experiences within technical systems. On one hand, we are witnessing humans becoming nothing more than digital objects themselves. However, on the other hand, we may also appreciate that they are integrating with machines, inaugurating a new set of operations under the names of *social computing* and *crowd sourcing.* We now have two fundamental understandings: first, that technical individuals individualize (Part I) by adopting and creating an associated milieu to stand independently, and second, that individuals individuate themselves through the collective—an assemblage or a network of relations and associations in its world (Parts II and III). To go into this further, we will need to address the concretization of digital objects.

From GML to HTML: Form as Technical Tendency

The development of technicality is a process motivated by various interruptions and discontinuities. New technologies are able to cut through the lineage, giving it new directions. These directions may collide and diversify its progress into different paths; however, these diversities will be synchronized by a dominant technical tendency. The French paleontologist and paleoanthropologist André Leroi-Gourhan distinguishes technical tendency from technical fact. The former is universal and abstract, whereas the latter is particular and concrete, closely related to its milieux, that is, geography, ethnicity, climate, and so on. We can further distinguish different degrees of fact according to different modes of adaptation within ethnic groups. Technical tendency is inevitable and foreseeable; technical fact is unforeseeable and requires certain local inventions rather than direct borrowing from other groups.[23] Leroi-Gourhan gave the example of forging. There are no technical tendencies of forging, only technical facts that depend on a varied range of conditions such as fire, metal, combustion, fusion, commerce, mode, or religion. The technical tendency is the force that traverses the various milieux and cultural differences, for example, the universal invention of wheels as a means of carrying heavy loads and handles for flint.[24]

The separation of form and matter, as evident among technical inventions, is a technical tendency in this sense. Digital objects follow such a tendency. The semantic web is a specific technology utilized in computation among many users. It subsequently deviates from IBM's Generalized Markup Language (GML) and from knowledge representation in AI (while incorporating some of their core concerns). Simondon called this process "the time of relaxation," which equates to "the real technical time. It can become more dominant than all other aspects of historical time, to the extent that it can synchronize all other rhythms of development and appear to determine the whole technical evolution, whereas in fact it merely synchronizes and induces evolution phases."[25] Synchronization means convergence, which also demands a new form of technicity. This technical time is also the time of the technical perfection of objects, regarded as "a practical quality or, at the very least, the material and structural support for certain practical qualities."[26]

GML was invented in the late 1960s by IBM, at a time when the Web hadn't yet come into being. It served as a solution to a project that would require the integration of a text editing application with an information retrieval system and a page composition program. These applications could not be run on the same machine until Charles Goldfarb and his colleagues invented GML in 1969, a markup language that standardized the structure of the document:

> This analysis of the markup process suggests that it should be possible to design a generalized markup language so that markup would be useful for more than one application or computer system. Such a language would restrict markup within the document to identification of the document's structure and other attributes. This could be done, for example, with mnemonic "tags." . . . The actual processing commands, however, would not be included in the text, since these could vary from one application to another, and from one processing system to another.[27]

GML consists of application documentation, which defines the data according to tags, and Document Type Definitions (DTDs), which subsequently define these tags. We can draw two conclusions here: (1) the markup language gives "semantic" meaning to the data through the distinction of tags, so that the application will be able to process the data as an object and parse useful information, which will result in the first step of data organization, and (2) the markup language provides a solution to the problem of the incompatibility of applications and machines; in other words, it can connect all machines by presenting them with a common protocol. The concept of universality is very important in the history of the development of the Web, which, as conceived by Berners-Lee, is a universal space.[28] GML separates the content from the form (metadata scheme) by acquiring the knowledge of the form, whereby the machines are not required to understand the semantic meaning of the entire content. This universal space is also determined by the universalization of the forms involved. These can be in the form of metadata schemes, protocols, or any other standard forms. This form versus content–matter hylomorphism has been a key concept in traditional metaphysics since the time of Plato and Aristotle. Matter subsumes itself as forms to actualize itself. Form is also a way of accessing the universal, because it provides idealities and particularities.

In 1986, the International Standard Organization (ISO) adopted an advanced version of the GML—later known as SGML, or Standard Generalized Markup Language—which prepared the pathway for the establishment of HyperText Markup Language (HTML) in 1991.[29] HTML is a subset of SGML, but with a fixed DTD. The motivation behind HTML, following SGML, was strategical and partly political, as SGML was the dominant protocol at that time, and HTML can hence be more easily accepted by the community. Nevertheless, its separating of content and form was also a step with technological significance. Berners-Lee wrote that "an architectural rule which the SGML community embraced is the separation of form and content. It is an essential part of Web architecture, making possible the independence of the device mentioned above, and greatly aiding the processing and analysis."[30]

Hylomorphism and Individualization

Here we should first place the concept of *hylomorphism* in its correct critical position. It is the most intuitive idea about technology, as suggested by Aristotle when he stated, "In speaking here of matter I have in mind, say, the bronze of a statue, while by shape-form I mean the geometry of the object's appearance and by the composite the statue itself as a whole entity."[31] One can make the criticism, as both Simondon and Heidegger did, that matter is not the passive object of the form but rather that form derives from matter. A good artisan creates the statue based on a particular status of the material or in seeing the form arise out of matter.[32] This critique is nevertheless based on human experience, and it was valid specifically within the age of artisanal production. In the age of mass production, however, this superiority of matter over form is reversed, because it is no longer a question of human skill but rather of the machine standards that create such forms. Form and matter here have two contrasting meanings: (1) form is the compensation for the machine's inability to understand the semantic meaning of the content (comparable to the metaphor of molding, which is always a standard), and (2) form activates a pursuit of ideality that becomes a point of convergence for Western metaphysics with modern science and technology, or what Martin Heidegger would call the onto-theological constitution of things. The conceptualization of form over matter in the age of machine production exposes an innate contradiction within modernity. On one hand, the production process has sped up significantly due to the homogenous mold, which largely ignores the singularity of matters. On the other hand, form replaces all situational discourses with a set of rigid rules that further constitute various forms of life externally. This double-bladed argument continues to fuel an ongoing social debate, and yet a radical interpretation of form is still lacking.[33]

The architect Christopher Alexander, in his book *Note on the Synthesis of Form,* writes that "the ultimate object of design is form. The reason that iron filings placed in a magnetic field exhibit a pattern—or have form, as we say—is that the field they are in is not homogeneous. If the world were totally regular and homogeneous, there would be no forces, and no forms. Everything would be amorphous. But an irregular world tries to compensate for its own irregularities by fitting itself to them, and thereby takes on form."[34] For Alexander, a design problem can only be solved by form, and the content of the problem is defined by its context. This somewhat resonates with what we have seen in the introduction of the computationism of Chaitin and Fredkin. It is therefore necessary to distinguish the form as a technical tendency from the perception of technical objects in terms of their forms. However, in contrast to this conception of form as the ultimate force of production, Simondon suggests that a tool "is not made of matter and form only. It is made up of technical elements arranged from a certain system of usage and assembled into a stable structure by the manufacturing process."[35] Despite the fact we know that mass production is mainly based on molding and the form–matter logic inscribed in it, the technical process cannot be simply explained by the principle of hylomorphism. The identity of a technical object equates to the totality of its production, as opposed to its form and matter. Simondon puts this in a rather extreme way: "There would be no exaggeration in saying that the quality of a simple needle expresses the degree of perfection of a nation's industry."[36] This marks the departure from the individual determined by form toward a broader discourse of systematic determination. Indeed, both processes point to what Simondon calls the "historical singularity": production itself is always the product of a historical moment distributed throughout the entire technical ensemble. Simondon suggests that despite hylomorphism being insufficient to account for the current nature of technological production, it is still nevertheless an intuitive mode of thought that remains a dominant engineering principle. My hypothesis is that under different historical and technical conditions, hylomorphism produces something other than its intended effects in material terms. It consequently exposes the limits of the thinking that reproduces itself; hence our analysis must first place form under suspicion and reposition it as our analysis unfolds.

HTML was implemented for the World Wide Web in 1991 and has remained the standard language that we use today. During the early days of the HTML markup scheme, metadata mainly focused on the structural, visual, and hypertextual representations of the page. The formalization and limitation of vocabularies has reduced its complexity, producing a light and portable language. In comparison with the Java programming language and the Web-based Java applet, HTML is very limited in terms of its programming power. Berners-Lee calls this approach based on simplification the *principle of least power.*[37]

A metadata scheme, as a relatively weak language, expresses only forms, instead of having the capacity to manipulate forms and objects, which is what occurs within the Java programming language. HTML uses a set of standardized tags to indicate content representation in a logical format. As in the simple example of HTML in Figure 8, <p></p> denotes the inclusion of a paragraph (as structural), denotes a bold font (as visual), and denotes a hyperlink (as hypertextual). We can probably say that HTML is a metadata scheme. As a fairly weak or

```
<!DOCTYPE html>
<html>
        <head>
        <title>Hello World</title>
        <head>
        <body>
            <p><b>Hello World!</b></p>
            <p><a href = http://helloworld.org>hello world</a></p>
        </body>
</html>
```

Figure 8. A simple example of HTML.

The IMG element allows another document to be inserted inline. The document is normally an icon or small graphic. This element is *not* intended for embedding other HTML text.

SRC	The value of this attribute is the URL of the document to be embedded. Its syntax is the same as that of the HREF attribute of the A tag. SRC is mandatory.
ALIGN	Take values TOP or MIDDLE or BOTTOM, defining whether the tops or middles or bottoms of the graphics and text should be aligned vertically.
ALT	Optional text as an alternative to the graphics for display in text-only environments.

Figure 9. Specification of an image in early HTML protocol.

ineffective programming language, it does not provide the machine much information regarding the data on the page, being something external to the object it encodes. The same thing can be said for the use of images; for example, you can see in Figure 9 the appropriated tags used to describe an online image in the early HTML documentation, dated 1993.[38]

As we can see in Figure 9, the image should be a "small image" or "icon"; it is not possible to insert large images. The SRC indicates the URL, ALIGN indicates the visual display, and ALT indicates "alternative text," which is "optional" and is the only place where additional metadata (without a semantically specific tag) can be added. These tags equate to all that a "digital image object" was on the World Wide Web in the year 1993. Then, in 1994, HTML 2.0 was produced, followed by the draft of HTML 3.0 in 1995, followed by the release of HTML 3.2 in 1997. We can see that,

```
      <!-- To avoid problems with text-only UAs as well as
    to make image content understandable and navigable
    to users of non-visual UAs, you need to provide
    a description with ALT, and avoid server-side image maps -->
<!ELEMENT IMG - O EMPTY                      -- Embedded image -->
<!ATTLIST IMG
  %attrs;                                    -- %coreattrs, %i18n, %events --
  src         %URI;          #REQUIRED  -- URI of image to embed --
  alt         %Text;         #REQUIRED  -- short description --
  longdesc    %URI;          #IMPLIED   -- link to long description
                                           (complements alt) --
  name        CDATA          #IMPLIED   -- name of image for scripting --
  height      %Length;       #IMPLIED   -- override height --
  width       %Length;       #IMPLIED   -- override width --
  usemap      %URI;          #IMPLIED   -- use client-side image map --
  ismap       (ismap)        #IMPLIED   -- use server-side image map --
  >
```

Figure 10. Specification of an image in HTML 4.0. http://www.w3.org/TR/1999/REC-html401–19991224/struct/objects.html#edef-IMG.

gradually, further tags are added as the original tags are refined. HTML 3.2 introduced tables, applets, text flow around images, subscripts, and superscripts.[39] We can compare this with the later version, HTML 4.0, as recommended by W3C in 1997 (see Figure 10).

We can see that there were some improvements made in HTML 4.0 (or perhaps one can say it is a better "form"). Many more tags are available, such as those that specify the size of the image. We can see that it is no longer limited to "small images" and "icons." The information is nevertheless still very limited, and it is nearly impossible for the computer to be able to identify what the picture is really about. One can still fill in <alt> to provide a short description of the image, although the computer would not be able to understand this unless it were able to interpret natural language. In fact, throughout the script, the term "object" is taken for granted without any explanation. There are two interesting tags we should pay attention to here: "usemap" and "ismap." These tags equate to two different types of image maps, allowing further specification of what the image really is by linking an intended part of it to another URL. "Ismap" is a server-side image map; it is only designed for very old browsers that do not recognize "usemap" (which is a user-side image map). The image map refers to those of its relations that are external to the image itself, whereby we may begin to notice that the individual does not exist within its own terms but is always related or linked to something else external. Above all, however, the most critical aspect of HTML 4.0 is that it is fully integrated with Cascading Style Sheets (CSS), allowing a more advanced format definition and the presentation of a web page. Objects (both texts and images) can then be described in terms of markups, which make explicit their meanings, and can now be further formatted in terms of their appearances. We should also recognize that this is the process of objectification *as* concretization. The late 1990s saw the increased emergence of multimedia data in the forms of Shockwave, Flash, MP3, and so on, which naturally demanded an improved means of representation. Without these descriptions, the search engines would not be able to locate the data, and the data would eventually dwell in the dark corners of cyberspace, to remain forever lost and unknown. This outlined problem (the lack of semantic meaning) would later be addressed by the recommendation of eXtensible Markup Language (XML).

XML and the Rise of Web Ontologies

XML was also an adaptation from GML, or rather SGML with a simplified syntax. The development of XML was primarily established to improve the lack of flexibility of HTML and to lower the barrier of SGML, which was found to be too heavy to be used on the Web. XML also plays a significant role in what I mentioned earlier as the "time of relaxation." Around the year 2000, there was the dichotomy between the Microsoft Windows (.Net) and Sun Java (J2EE) frameworks; XML subsequently formed frameworks external to these, providing a bridge between the two technologies.[40] In comparison with SGML, on one hand, XML placed some stricter rules on syntax, for example, denoting an unclosed tag as a mistake; on the other hand, it discarded some of the complicated syntaxes of SGML. One example of these differences is that for SGML, a DTD must be "valid," whereas for XML, any well-formed data with a proper tag syntax will be allowed (even without a DTD). This makes XML easy to use, even for those who are not already familiar with the SGML specifications. A user would easily be able to create an XML file describing an image according to common sense and previous knowledge. See Figure 11.

If we compare this with the earlier example of HTML 4.0 (Figure 9), XML can achieve a lot by restricting the user-programmer to providing information on the objects according to what is in demand or what is

```
<image>
        <title></title>
        <author></author>
        <link></link>
        <camera></camera>
        <location></location>
</image>
```

Figure 11. Simple example of an image in XML format.

considered to be useful. In the case in which a computer program is written and designed to analyze data, it is subsequently able to track down information such as who retrieved this photo or image and where it was taken. Such information can be very useful for information retrieval, enabling the programmer to extend the XML by adding more attributes for a more detailed description in simple terms. Thus the description might state who is represented in the picture, when it was taken, and so on. This is the fundamental idea of XML, though there are many other technical details that will not be covered here. In terms of objectification, XML goes much further than HTML by imposing a *more flexible yet stronger form.* Parallel to this, it is able to share the restricted semantics with any ordinary user. In 2000, W3C recommended XHTML (which is a combination of HTML 4.0 and XML 1.0) to adopt the HTML set of attributes toward structural and visual representation and include the syntax of XML for structured content presentation. For example, "namespace" (which can be understood as a prefix) is added, so prefix1:cat and prefix2:cat can be distinguished despite the fact that they share the common suffix "cat." With these tags, a computer program will be able to extract these data from the web page automatically.[41] What is interesting here, and also relevant to our discussion of hylomorphism, is the evident failure of XHTML2, which was introduced in 2002 and officially "died" in 2009. XHTML2 has been described as "a beautiful specification of philosophical purity that had absolutely no resemblance to the real world";[42] however, its fundamental problem was that it was simply too distant from the technical reality. It was neither backward compatible nor compatible with the common practices of developers. Because only a few developers used XHTML2, its death and disappearance did not cause much affect.

In April 2011, W3C introduced HTML 5.0, a single language that integrates both earlier versions of HTML with XHTML. They introduced two very significant changes that are relevant to our discussion here. The first change was the introduction of Application Programming Interfaces (APIs, for example, audio and video players, drag-and-drop APIs), which extend HTML from a textual representation to some forms of pseudo-software. The second improvement made by HTML 5.0 was to introduce a further series of <object> diversities, including <audio>, <video>, <canvas>, and so on. Many more attributes were added to enable better grasp of the objects, or rather, we may say, to achieve a greater "objectification" of data. Let us consider the example of <img> in HTML 5.0. One is now able to indicate the appearance of an image according to its status as either "unavailable," "partially available," "completely available," or "broken," as well as to display the downloading status when showing the images.[43]

We have noticed that within digital objects, the *concept of form* continues to serve as a technical tendency within computing, although it is now *standards* that have become universal. Forms are abstract schemes, and standards are concrete objects. We must also bear in mind the other aspects of standardization that are political and economic. First, it is an enforced technical process that pursues the compatibility of computation on global scales, and second, it is also a marketing strategy that builds up networks of partners and alliances. We focus only on the first aspect here. Because XML is freely extensible, some programmer may use scheme A to describe an object, whereas another may prefer scheme B, the result being that there will be a lack of objectivity. Objectivity in this context should be understood to refer to the character of elements that come from an object itself and remain universal to the observers. In science, for example, an objective method and an objective mode of observation exclude all forms of subjective and psychological interpretation. This understanding of objectivity bears within it a paradoxical relation to universality. We have already discussed the first meaning of universality, in the context of the separation of content from form. Being universal, the form becomes a shared framework for every machine, whereby its modification may lead to incompatibility. So to disclose a form without variation, it must be seen objectively. This highlights one of the problems associated with the freely extensible XML. As XML guarantees the format and validity of the form, it does not guarantee the objectivity of the scheme (the set of tags used, in this case). This objective–universal correlation can be contrasted against another kind of universality, one that allows for differences. Berners-Lee was certainly not unaware of this contradiction, as he compared this second understanding of the universal with the Unitarian Universalism religion.[44] Unitarian Universalism incorporates doctrines from all religions, creating a space for differentiation. For Berners-Lee, this is one of his key design principles for the Web, for example, in his proposal concerning lightweight HTML and low-level XML. The minimization of forms allows for further extension and adaptation.

This ambiguity becomes obvious when XML is conceptually modified into an ontology. In an article published in *Scientific American* in 2001, Tim Berners-Lee and his collaborators proposed the idea of the semantic web as a place where, they envisaged, all objects are represented by standard ontologies. These ontologies, based on XML syntax, regulate the semantic meaning of the objects in a way that enables machines to understand and manipulate data. Each object–predicate is identified by a unique URL, which serves as an ID within the digital milieu. So not only do the objects have identities, but their components or predicates also have identities and are thus subject to control and manipulation. Berners-Lee and colleagues began with an imaginary scenario: that Pete and Lucy's mother needed to see a specialist on a regular basis. Their semantic web agent (a computer program that is capable of analyzing ontologies) can tell them the location of the hospital, the best way of getting there, how to make an appointment with the clinic's agent, and how to reschedule their own work to fit in with their mother's appointments. Berners-Lee continues to describe the semantic web as follows:

> The Semantic Web will bring structure to the meaningful content of Web pages, creating an environment where software agents roaming from page to page can readily carry out sophisticated tasks for users. Such an agent coming to the clinic's Web page will know not just that the page has keywords such as "treatment, medicine, physical, therapy" (as might be encoded today) but also that Dr. Hartman works at this clinic on Mondays, Wednesdays and Fridays and that the script takes a date range in yyyy-mm-dd format and returns appointment times.[45]

What exactly is the difference between ontologies and XML? A technical explanation expresses the following: (1) "an ontology differs from an XML schema (which describes the structure of a XML document) in that it is a knowledge representation, not a message format" and (2) "one advantage of OWL [Ontology Web Language] ontologies will be the availability of tools that can reason about them."[46] These two points of comparison require further discussion. Knowledge representation here doesn't mean mere representation but is necessarily objective, so that what it presents can be recognized as an object instead of a set of textual messages. To reconcile objectivity and the two differing forms of universality, two presuppositions are to be made: (1) that there is an objective representation of things and (2) that their translatability can take place in between two representations of things, allowing the object from context A to be translated into an object from context B. This translation process is simply the translating of vocabularies and prefixes. If we stop to consider this for a few seconds, we realize that translation would be impossible without the second presupposition. What dominates here is the concept of objectivity as universal. Facts can only be meaningful when they can be subsumed to forms, whereby they can be regulated and calculated. Let us now examine the example in Figure 12 of an image in an ontology-driven information system. The figure shows a sample of data that were extracted from Flickr in 2007 (this is just a small sample of the metadata contained by this chosen image;[47] these data were extracted using Flickr's public API function [Flickr.photos.getInfo]).[48]

The extracted data sample appears to be relatively large (considering it was already obtained a few years ago, it can be larger today); "what an image is" is apparently much greater than the sum of the definitions and descriptions by which HTML 4.0 designates an image. We easily see that the information given here is much more extensive than that which we derive from actually looking at a picture and includes geodata, camera information, the time of uploading, different reference IDs, friends' information, and so on. We can even see that the image object simultaneously embeds various camera objects, author objects, location objects, and so on. An object is therefore determined not just by a single form but by multiple forms (or by its ground, to echo Simondon). We shall return to the concept of ontology and relationality in the subsequent chapters of this book; our focus for now is simply to grasp the process of individualization—which is not simply the concretization of the object but also the creation of technical associated milieux without which it cannot function. Throughout the concretization process from GML to web ontologies, a digital object can be described in a more and more detailed manner, at the same time

comments:	1
dates:	
dateuploaded:	8/19/07; 2:44:43 AM
lastupdate:	8/19/07; 2:44:43 AM
posted:	8/19/07; 2:44:43 AM
taken:	8/18/07; 10:44:43 PM
takengranularity:	0
description:	Sent from my iPhone
editability:	
canaddmeta:	0
cancomment:	0
farm:	2
geoperms:	
iscontact:	0
isfamily:	0
isfriend:	0
ispublic:	1
id:	1166257196
isfavorite:	0
license:	5
location:	
accuracy:	15
country:	United States
county:	Santa Clara
latitude:	37.444293
locality:	Palo Alto
longitude:	-122.160591
region:	California
notes:	
72157601607070993:	
author:	22221172@N00
authorname:	scriptingnews
h:	20
id:	72157601607070993
title:	Blue Chalk Cafe

Figure 12. A sample of data extracted from an image on Flickr.com.

establishing material connections over a broader milieu across further platforms and interfaces. The ontologies are then continuously formatted through the Resource Definition Framework (RDF) (proposed by the W3C). RDF is also based on the syntax of XML, thus having a logical form. An RDF statement follows the rules of first-order logic, such as in the following coding:

<subject>+<predicate>+<object>

This simplicity allows for an inference language and a succession of logical operations on a machine level. The transition from XML to a more logi-

w: 68
x: 280
y: 14
originalformat: jpg
originalsecret:
owner:
location: USA
nsid: 22221172@N00
realname: Dave Winer
username: scriptingnews
rotation: 0
secret:
server: 1007
tags:
barcampblock:
author: 22221172@N00
id: 380915-1166257196-13743477
machine_tag: 0
raw: barcampblock
heatherharde:
author: 22221172@N00
id: 380915-1166257196-2504570
machine_tag: 0
raw: Heather Harde
techcrunch:
author: 22221172@N00
id: 380915-1166257196-3057
machine_tag: 0
raw: TechCrunch
title: Heather Harde, TechCrunch CEO
urls:
photopage: http://www.flickr.com/photos/scriptingnews/1166257196/
visibility:
isfamily: 0
isfriend: 0
ispublic: 1

cally defined RDF is a significant move toward an AI-motivated Web. In 2002, another standard OWL was introduced to improve the performance of logical operations. OWL is precisely the language developed by the W3C for ontology construction. There are three versions of OWL, each differentiated according to its different purposes and complexities per use. The highest and most sophisticated level of OWL is a logical language that formulates variables such as class, property, relation, and cardinality. The use of OWL will benefit from the "availability of tools that can reason about them," or in the words of Berners-Lee, the machine can "pretend to think."[49] The relations between OWL, RDF, First Order Logic (FOL), and Description Logic (DL) are further addressed in chapter 5.

To summarize the preceding discussion of the individualization of digital objects, we have recognized that this process embraces three key concepts: *universality, interoperability,* and *extensibility.* These are all, coincidentally, synonyms for "objectivity." Yet we can see that this objectivity is in fact in the constant process of evolution or individualization. This objectivity is not limited to human understanding but also requires machine interpretation. The discussion around the objectification and individualization of the "digital milieu" has only very recently entered a more mature phase. *Horizontally,* we can see that forms have developed from GML (to allow compatibility between programs within a machine) to ontologies (across the Internet, in between machines), a process that gradually involves a greater number of objects, machines, and users to maintain its functionality and stability. We can also approach the associated milieu as a measurement of interoperability and compatibility here. *Vertically,* we can see that digital objects are always within a process by which they gradually become more concrete and individualized. HTML is simply a formatted text file full of data, whereas RDF is a complicated document coded with advanced programming and logical developmental capacity. The RDF- or OWL-formatted ontologies thereby become similar to an object in object-oriented programming (OOP). OOP has three important properties: abstraction, encapsulation, and inheritance, whereby a class can be overridden to generate new classes, which subsequently inherit certain properties and functions from the parent class. We can identify all these properties within the current concept of web ontologies.

The genesis of digital objects forms the beginning of an investigation into the dynamics of these objects, aimed at developing the scope for a better understanding of the meaning of this new genre of industrial objects. Following on from Simondon, we can apply the concept of genesis to digital objects, while additionally discovering new dynamics that we previously would have ignored and dismissed as mere objects. The genesis of digital objects is the process of concretization and materialization, first of forms, second of explicit relations and connections between objects. We can also see this as an evolutionary process of interobjectivities in contrast to intersubjectivities, which we further elaborate in chapter 4. Now at the end of this chapter, we have arrived at the creation of ontologies after a discussion of forms as a general technical tendency. Now we shall ask the question, where do these ontologies come from? and seek to understand what is involved in the word and concept of *ontology* detaching from its metaphysical context and becoming purely practical. In the next chapter, these questions are addressed in greater depth through an investigation of the theories of Brian Cantwell Smith, Edmund Husserl, and Martin Heidegger concerning objects and ontologies.

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· CHAPTER 2 ·

Digital Objects and Ontologies

The Origin of Digital Objects

In the previous chapter, we introduced the subject of this book—digital objects—and analyzed its technical lineage in terms of markup languages. But the investigation cannot end here, because what we have discussed is only a partial interpretation of Simondon's understanding of technical evolution. The goal of this book is rather to investigate the existence of the digital object, mediating on its production, its implementation, and its use. We may diagrammatically grasp the "life cycle" of the digital object in terms of a triangle of processes (Figure 6). The first process is that in which the ontologists and computer scientists create a metadata scheme or ontologies for digital objects; the second process is the implementation of these schemes in databases and pieces of software, which creates a milieu for the digital objects. The digital object can hence be seen to exhibit its modes of being by situating itself within the digital milieu. The third process to be understood is that by which these objects and the machines construct a technological system, which further integrates human users into it. This triangle is composed of different technical ensembles.

We may want to address the first step concerning the origins of these objects: where did they come from? I said "origins" instead of "origin," because they are always plural. One lineage entails multiple origins, and each origin presents us with philosophical thoughts concerning the existence of objects. The quest for origins is a *method* for discovering the knowledge (for example, Husserl's *The Origin of Geometry*) that we already established at the very beginning and that has already been obscured by historical developments. Some origins still have effects in the present, but their sources are largely forgotten. A discussion of what Simondon calls the "absolute beginning" of technical objects will serve as the first step for our discussion. In the evolution from diode to triode, and then from to tetrode and pentode—the typical technical objects that Simondon used for illustration—he proposes that the absolute beginning is not the diode but is to be found "in the condition of irreversibility of the electrodes and the phenomenon of the transport of electric charges across the vacuum."[1] This absolute beginning is the irreducible technical principle that serves as the foundation of technical objects. Can we pose the same question with regard to digital objects? How can we define their absolute beginning? If we trace the footprints, we can always find several different histories, for example, the digital object's origin in military technology, in AI, or in the Text Encoding Initiative (TEI) for humanities data, but these can be considered relative origins. They certainly deserve books within the field of history, but here we need to take a different position. Concerning this absolute origin, I propose two directions, one purely technical and the other philosophical. The former is concerned with the syntactic operation of a machine, that is to say, a grammatical structure that machines can interpret; the latter has been an ongoing philosophical quest for ontology since Aristotle.

First, we shall look into the notion of ontology. By the end of the preceding chapter, we had arrived at an understanding of web ontologies as the current phase of concretization of digital objects. It is also necessary to make the remark here that ontology has been around long before the web ontologies. Ontology was first formulated by Aristotle as "being qua being," or more precisely, "a discipline which studies that which is, insofar as it is, and those features that it has in its own right."[2] The development of ontology can be summarized, as we have already seen in the introduction to this book, in terms of ontologies and Ontology. The former designates theory of formalization and representation; the latter refers to what Heidegger calls fundamental ontology. The former concerns being *(Seiendes)*; the latter concerns Being *(Sein)*. On its surface, this constitutes an opposition between Ontology and ontologies (or ontics, in Heidegger's terms). We can probably say that Ontology is a critique of ontologies; however, we will also see later how ontologies become the material support of Ontology.

Second, we shall address the "syntactic nature" of computation. Computational machines are generally described as "syntactic" rather than semantic machines; syntaxes are derived from *forms* rather than *contents.* The computer doesn't actually understand the meaning of the sentence but only its syntax. John Searle's Chinese Room thought experiment critically illustrates that "semantics is not intrinsic to syntax."[3] The experiment goes like this: imagine a non-Chinese speaker is sitting in a room, and a second person, who cannot see into the room, submits commands written in Chinese to him; the man inside the room—a black box—has to choose the right responses (with the correct Chinese characters) according to a set of rules that have already been provided. This "computer" passes the Turing test[4] and has the ability to convince the observer that it understands Chinese. It looks *as if* the computer understands Chinese, when in fact it doesn't have any clue as to the meaning of the Chinese input; rather, it merely executes the commands or syntaxes according to rules that have been produced for it in advance. Searle further pointed out that such machines are not really following rules but are made to seem *as if* they are following rules. These syntaxes—computational states—are not inherent in physics but rather are assigned to a physical system; in other words, they don't bear casual powers.[5] Indeed, we can draw a parallel with the hylomorphism that we discussed in the previous chapter. Machines deal with commands not according to their meaning but according to the assigned syntax, which follows the rules of logic and the orders of symbols. For example, given a simple XML markup of a book such as <book><title>On the Existence of Digital Objects</title></book>, the computer doesn't necessarily know what "title" means, but when it sees the request "title," it retrieves what is inside the field "title." It is this principle by which machines "think." The question of whether a computational machine has semantics will be elaborated later. For now we need only to recognize that the syntactical nature of computation and markup languages makes the "semantics" in "semantic web" suspect.

This chapter will hence address these two issues—the notion of ontology and the relation between syntax and semantics—through a progressive study of the theories of various ontologies, while placing special focus on the cognitive and computer scientist Brian Cantwell Smith's *foundational ontology,* Edmund Husserl's *formal ontology,* and Martin Heidegger's *fundamental ontology.* The relation between ontology and semantics is not immediately evident here, but it will become clear that the discussion of semantics and syntax directs us toward an inquiry into the ontology of computation. The aim here is to argue that these two notions of ontologies cannot be separated from each other if we are to understand the existence of digital objects and that syntax and semantics should not be opposed in the way Searle has set out; instead, through analyzing these differences, I hope to show that these two oppositions need to be resolved by third terms, that is, ontogenesis and relations.

Onto-epistemology and First Philosophy

The American philosopher V. W. O. Quine has concisely summarized the study of ontologies: "The curious thing about the ontological problem is its simplicity. It can be put in three Anglo-Saxon monosyllables: 'What is there?'"[6] Let's first bear in mind that it is not a question of "the what it is (τὸ τί ἐστι)" that Aristotle asked but rather "what is there." There are two broad dimensions of the notion of "what is there": there are things that exist even though we don't know about them; there are things that we know to exist or have existed. Ontological questions concern the former, whereas the latter are considered the subject of epistemology. This relation between ontology and epistemology seems completely obscure: how can we understand the existence of something that we don't know to exist? The question of the existence of God is subject to this difficulty and had occupied the central theme of medieval metaphysics. Even in terms of those things supposed to be known to exist, it is necessary to consider which particular person makes such a claim, which in turn depends on his cultural background and similar factors. Ontologists are very familiar with this dilemma. As Quine wittily puts it, "in any ontological dispute the proponent of the negative side suffers the disadvantage of not being able to admit that his opponent disagrees with him."[7] To disagree with someone's ontology is to admit that there are things that I don't countenance, which in turn becomes a negative admission of my own ontology. "What is there?" is not a question only for philosophers but also for scientists, and even for robots. So everyone actually encounters the same deficiencies of ontologies mentioned by Quine.

These defects were not happily admitted, because they denounced the possibility of universal categories (not only of grammar[8]) that would be accurate enough to describe the world. Philosophers after Aristotle wanted to search for a method that could firmly grasp the question of ontologies. Commenting on Aristotle's effort to develop his ten categories, Kant wrote, "Locating these basic concepts was a project worthy of an acute man like Aristotle. But having no principle he snatched them up as

CATEGORIES	GENRES
Transcendent Relations	General, Mixed, Of Action
Unclassified	Discourse, God, World, Element, Stone, Metal
Plants	Herb Leaf, Herb Flower, Herb S. Ves., Shrub, Tree
Animals	Exsanguinous, Fish, Bird, Beast
Parts	Peculiar, Genera
Quantity	Magnitude, Space, Measure
Quality	Natural Power, Habit, Manners, Sensible Quality, Sickness
Action	Spiritual, Corporeal, Motion, Operation
Relation	Economic, Possessions, Provisions, Civil, Judicial, Military, Naval, Ecclesiastica

Figure 13. John Wilkins's ontology.

he came upon them."[9] Throughout history, we have seen many attempts to define such a universal language. Perhaps every known philosopher, and at least every epoch, has invented its own ontologies. In the introduction to the book *The Order of Things,*[10] the French philosopher Michel Foucault draws on the ontological scheme of seventeenth-century English philosopher John Wilkins, Bishop of Chester, and a parody made of it by the twentieth-century Argentinean writer Jorge Luis Borges, to demonstrate this problematic search for essence. Bishop Wilkins, in his *An Essay towards a Real Character and Philosophical Language,* classified beings into nine categories with forty genres as set out in Figure 13. Wilkins's taxonomy was designed to serve as the basis for an ideal language that would express every possible concept via systematic composition using a list of basic concepts.

In "The Analytical Language of John Wilkins," Borges cites doctor Franz Kuhn, who attributed to a certain Chinese encyclopedia titled *Celestial Empire of Benevolent Knowledge* the following classification of animals:

> (a) belonging to the Emperor, (b) embalmed, (c) tame, (d) suckling pigs, (e) sirens, (f) fabulous, (g) stray dogs, (h) included in the present classification, (i) frenzied, (j) innumerable, (k) drawn with a very fine camelhair brush, (l) et cetera, (m) having just broken the water pitcher, (n) that from a long way off "look like flies."[11]

Borges's writing points to the problem of classification, as he says, "It is clear that there is no classification of the Universe not being arbitrary and full of conjectures. The reason for this is very simple: we do not know what thing the universe is."[12] This skepticism toward knowledge has its origin in the hypothesis that we don't know the universe at all. Here the word "universe" becomes the object we scrutinize. And the question becomes, on what ground do we know what a thing is? We can state this in expanded form as a threefold argument. First, how can we be sure that what we have registered as existing really does exist? This is not to suggest that things don't exist unless they can be verified by the mind but, rather, how can we know that they exist at all? Second, how do we know that what we know is the totality of the object itself and not just a part of it? Again, in Wilkins's example, is there anything beyond our own experience and imagination? Third, how can I be certain that I share the same registration of the world as others (this the question of pluralism, of multiple worlds)? Worlds can be different from each other personally, culturally, politically. Borges's rejection of Wilkins's ontology demonstrates differences at a personal level, because Borges's world is different from that of Wilkins. The example of the Chinese encyclopedia demonstrates cultural differences. Of course, today we know that it was probably a joke, but what if it were true, and on what grounds should it then be rejected or denounced by Western epistemology?

We can conclude that ontologies are relatively true, because they depend on cultural differences. In fact, Émile Durkheim and his nephew Marcel Mauss showed in their work *Primitive Classification* that a social object is produced through its subsumption under social categories, which they call the "cultural character of categories of the understanding."[13] The theory of social categories for them is the first philosophy and is comparable to Aristotle's ontology. Their classification has its origin in the social structure, for example, in the correlation between classification and the division of clans, and ultimately has a religious origin expressed in totems. Durkheim and Mauss saw categories as technical fact rather than technical tendency. We can say that there is tendency within totemism, and that totems always manifest as different facts in different clans; hence one can also say that categories or classifications of things are technical facts. Durkheim and Mauss bring down the transcendental characteristic of categories but produce a secondary artificial a priori that is both historical and technical. As Mauss claimed, the Durkheim school wanted to provide a sociological account of Aristotle's categories to resolve the problem of the first philosophy: where do these categories come from?

Today it seems puzzling enough that facts are becoming tendencies through standardization. Because the technical tendency of networking technics demands different orders of compatibility on global scales, ranging from the connection of physical optic cables to the development of network protocols and, with regard to digital objects as discussed here, the construction of categories, now we can easily admit that the construction of social categories basically has nothing to do with totems, which are identified as products of primitive societies. These categories traverse different ethnic groups and are propelled by the force of globalization. They are made universal through bureaucracy, by marketing campaigns, and above all by ignorance. For example, a few years ago in a W3C workshop in Barcelona in which I participated, a young engineer was very eager to propose that one can develop a set of minimum categories to describe digital objects, for example, everyone has a father or a mother. Another participant responded, how the case of Japan and China, where the uncle from the mother's side and the uncle from the father's side have different titles? Shall they all be called uncle? How then can this need for objectivity be addressed? And what kind of method should be employed instead of common sense?

Ontologies and Knowledge Representation

The idea of a universal language seems to have been defeated analytically, because the ontological commitments of the observers are sensitive not only to sentiments but also to cultural heterogeneity. We should note some of the further developments after this defeat: first, it marks the triumph of formal logic, which takes content out of "language" and deduces a pure "grammar" or "form"; second, it proceeds with the emergence of domain-oriented or specific formal ontologies in information systems based on practice and pragmatic reasoning; and third, it realizes the universalization of particular ontologies through technological globalization and industrial standardization, which we briefly discussed earlier. In computer science, there exists a large number of research projects on ontologies, and the investigations and proposals arising from them vary greatly according to their specific domains and approaches. In this section, we look at a "commonsense" approach to ontologies, and in a later section, we engage in a more focused discussion of formal ontology.

The current development of the "web ontologies" has taken a very pragmatic and simplistic approach—or perhaps one should say that it comprises a minimal number of categories concerning objects. A lot of the work on web ontologies emerged from an important subject in computing called *knowledge representation,* which has been an important topic for AI since the 1980s. The computer scientist Tom Gruber defines ontology as "a specification of a conceptualization."[14] He gives the further elaboration that "ontology is representation artefact (a specification), distinct from the world it models, and . . . it is a designed artifact, built for a purpose."[15] An ontology is the representation of the knowledge one has of the world, and it is composed of both a formal and an informal part: the formal parts work like axioms that allow meanings to be derived (syntax); the informal parts are, for example, explanations in a dictionary, composed of free texts (semantics to which machines are indifferent).

The definition proposed by Gruber is an attempt to formally represent the domain, and the relations between the objects within the domain, that are useful for the operation of the information system. But it is necessary to reflect not only on what he refers to as "conceptualization," that is, what is to be represented, but also "specification." Because machines in the mechanical age were isolated, information input and output were confined to the machine's predefined domain. However, in the information age, machines are connected physically and materially by communication networks; one function of the machine may simultaneously operate on different protocols and domains. Because these networks run across geographical regions as well as different cultures, they have to remain invariable. Besides domain-specific ontologies, "upper ontologies," which represent general concepts, are also required for translation between different domains. In this sense, we see that universal standardizations are driven by technical progress and knowledge transmission, which are inevitable processes. If we follow Tom Gruber, we may consider that computation proposes a more modest response by removing *universalis* and replacing it with *specialis.* Specification also refers to a pragmatic reasoning that would restrict questions according to certain specifics. Nevertheless, specification doesn't hold on the Web: because it is available for different users in different cultures, it is global from the very beginning, or it has already been dialectically sublated to the "universal," with the specifics remaining only a pretext.

To demonstrate this, we are going to look at two "upper ontologies" or "knowledge bases" to see the complexity of a single notion within a large domain as well as to observe the translation between different domains. One of the projects is CYC, which was founded in 1984 by Douglas Lenat as a knowledge base to represent what is called commonsense knowledge. The other one is SUMO (for Suggested Upper Merged Ontology), which seeks to serve a similar purpose. The project is now live, having accumulated up to twenty thousand terms and seventy thousand axioms.[16] Let's look at the definition and hierarchical relations of the term *transaction* in both domains.[17]

In the examples in Figures 14 and 15, we can see that the term *transaction* is situated at different levels of hierarchy and that the two ontologies don't use the same vocabularies to communicate. These "upper ontologies" are often used as higher-level ontologies to integrate different domain-specific ontologies, that is, by acting as reference points. Alternatively, if we consider further integrating these two large knowledge bases, a new knowledge base that includes at least the entire collection of both vocabularies will have to be developed. Initiatives like the Open Ontology Repository[18] are making such attempts. We should also consider the question of whether, when a specific ontology becomes a reference, it can be specific at all, or whether it has to carry some universal characteristics.

Husserl and the Origin of Formal Ontology

Another branch of study of ontology is formal ontology. In comparison with web ontologies that come out of practical needs and amateur practices, formal ontologies are philosophically informed applied ontologies. The works of Barry Smith, Nicola Guarino, Boris Hennig, and John Sowa are very important resources for understanding this discipline, and their philosophical rigor deserves further attention. Nicola Guarino criticized Gruber's understanding of "conceptualization" as being problematic because Gruber's understanding comes from AI textbooks, according to which it merely means "structure." It only conceptualizes a domain according to "extensional relations," for example, "the cup is above the table" ("above" is an extensional relation). Instead of extensional relations, he proposes to focus on intentional relations, for example, addressing what

Transaction—The collection of actions performed by two or more agents cooperating (willingly) under some agreement wherein each agent performs actions in exchange for the actions of the other(s). Note that a case of attack-and-counterattack in warfare is *not* a Transaction; nor is fortuitous cooperation without agreement (e.g. where a group of investors who, unknown to each other, all buy the same stock almost at once, thereby driving up its price). For transactions involving an exchange of user rights (to goods and/or money) between agents, see the specialization of ExchangeOfUserRights
Subtype of PurposefulAction, CooperativeEvent
PurposefulAction a specialization of both Action and AtLeastPartiallyMentalEvent. Each instance of PurposefulAction is an action consciously, volitionally, and purposefully done by at least one actor.
Subtype of Action, AtLeastPartiallyMentalEvent
Action *subtype of Event*
Event *subtype of Situation-Temporal, IntangibleIndividual*
Situation-Temporal *subtype of Situation, TemporalThing*
TemporalThing *subtype of Individual*
Individual *subtype of Thing*
Thing

Figure 14. Definition and hierarchical structure of the term transaction *in CYC.*

Transaction—The subclass of ChangeOfPossession where something is exchanged for something else. *subclass of ChangeOfPossession*
ChangeOfPossession—The Class of Processes where ownership of something is transferred from one Agent to another. *subclass of SocialInteraction*
SocialInteraction—The subclass of IntentionalProcess that involves interactions between CognitiveAgents. *subclass of IntentionalProcess*
IntentionalProcess—A Process that is deliberately set in motion by a CognitiveAgent. *subclass of Process*
Process—Intuitively, the class of things that happen rather than endure. A Process is thought of as having temporal parts or stages, and so it cannot have all these parts together at one time (contrast Object). Examples include extended 'events' such as a football match or a race, events and actions of various kinds, states of motion and lifespans of Objects, which occupy the same space and time but are thought of as having stages instead of parts. The formal definition is: anything that lasts for a time but is not an Object. Note that a Process may have participants 'inside' it which are Objects, such as the players in a football match. In a 4D ontology, a Process is something whose spatiotemporal extent is thought of as dividing into temporal stages roughly perpendicular to the time-axis. *subclass of* Physical
Physical—An entity that has a location in space-time. Note that locations are themselves understood to have a location in space-time. *subclass of* Entity
Entity—The universal class of individuals. This is the root node of the ontology.

Figure 15. Definition and hierarchical structure of the term transaction *in SUMO.*

is meant by "above." Hence Guarino has redefined ontology as "a logical theory accounting for the intended meaning of a formal vocabulary, i.e. its ontological commitment to a particular conceptualization of the world. The intended models of a logical language using such a vocabulary are constrained by its ontological commitment. An ontology indirectly reflects this commitment (and the underlying conceptualization) by approximating these intended models."[19] Guarino calls this type of ontology *formal ontology,* following Edmund Husserl.

Husserl first developed the concept of formal ontology in the first volume of *Logical Investigations* and subsequently in *Formal and Transcendental Logic.*[20] In *Logical Investigations,* Husserl describes formal ontology as the "eidetic science of the object as such."[21] This approach derives largely from Husserl's take on categories and forms, especially in terms of what he calls *categorial intuition.*[22] To put it in simple terms, the way we perceive an object, regardless of whether it is real or abstract, always corresponds to an intuition that is categorial and not purely temporal and spatial, as Kant had understood pure intuitions. These categories are formal in the sense of having an ideal form that corresponds to both the expression of the real object, for example, a white sheet of paper, and an abstract relation such as "part of." In *Formal and Transcendental Logic,* Husserl further develops his concept of formal ontology by contrasting it with "regional" or "material" ontology. "Regional ontology" concerns the regional essence of things, for example, a Cheshire cat with such and such properties (yellow in color, a smile without a face, etc.). So regional ontology is the categorization of the real and material, and it determines the hierarchy of genus and species. According to Husserl, this corresponds to Kant's "synthetic a priori." Formal ontology deals with the ideal, with "any object whatsoever" *(etwas überhaupt)* that doesn't belong to the material essence.[23] For example, relations between the universal and the particular, or between part and whole, are formal structures. Husserl's part–whole theory, developed in the third investigation, later serves as the foundation for modern mereology, as an alternative to set theory. The best example of formal ontology one can think of is geometry, which comes out of physical landscapes and objects, without being concerned with their material dimension, only their relations. For Hennig, "formal ontology studies the most general features of real objects by reflecting on the forms by virtue of which we identify them."[24]

The philosopher and ontologist Barry Smith takes a similar critique of Guarino that the AI researchers didn't pay enough attention to the parallel research in philosophical ontology. According to Smith, John McCarthy was the first AI scientist to discover this in the 1980s and has formulated his research on ontology through the reading of Quine: "list everything that exists, building an ontology of our world."[25] Smith distinguishes formal ontologies from formal logic. If every object could be approached in terms of formal truth (formal structures or relations in the underlying region of objects) and material truth (material structures or relations), and if form and matter are distinguished on the level of truth and the level of things, "then formal ontology consists in the investigation of formal structures or relations on this second level; it concerns itself only indirectly with formal truths on the first level."[26] Smith further distinguishes two approaches toward philosophical ontology: one is the Frege–Russell–Wittgenstein reductionist approach, the other the (early) Brentano–(early) Husserl–Ingarden approach that deals with experience.[27] Bearing this distinction in mind, it is, however, important to notice here that references to Husserl are always to his earlier work *Logical Investigations* rather than to *Formal and Transcendental Logic,* in which the notion of formal ontology is much more mature. Another definition from the social scientist Roberto Poli, who works in the field of formal ontology and the humanities, can further illustrate this. Similarly to Smith, Poli subdivides the "formal" of formal logic into "logical formal" and "ontological formal":

> Logical formal concepts are thus negation, conjunction, implication and quantifiers. Ontological formal concepts are: object, state of affairs, unity, plurality, number, relation, connection (Prolegomena), subject and determination, individual, species and genus, quality, cardinal number, order, ordinal number, whole, part, magnitude.[28]

This stroll through the definition of formal ontology intends not only to hint at the amount of research that has been done in this field but also wants to highlight its relation to Husserl's philosophy. Formal ontology is an area of study that attempts to understand the existence of objects in terms of different modalities and relations in and to the world. In comparison with the "commonsense" ontologies, we can see that it is more a philosophical task than one of mere inductive reasoning. However, we have to pay extra attention to the fact that this reading of formal ontology is a very specific take on Husserl, and one I doubt Husserl himself would have agreed with. Poli's description of it is reasonable to some extent, because it corresponds to the program of formal logic in *Formal and Transcendental Logic,* where Husserl in this first part of the book concludes that formal logic includes formal apophantic logic and formal ontological logic; the former focuses on judgments, the latter focuses on the "possible categorical objectivities themselves."[29] What is crucial, and that Poli didn't mention, is that, for Husserl, formal ontology as well as formal logic demands a transcendental foundation, and the part on formal logic is only a preparation for the second part on transcendental logic. Therefore I suggest instead that we ought to bear in mind that what lies behind formal ontology for Husserl is the phenomenological method, and phenomenology is the methodology of ontology, a point that formal ontologists have seemingly not appreciated.

Husserl's phenomenology aims to ground human knowledge and hence establish the foundation for all sciences. Cognitive science and computation's affiliation with the early Husserl coincide with Husserl's proposal for a pure logic through the study of intentionality. The word *intentionality* comes from medieval philosophy, in particular from the concept of intentional inexistence. It was used for an object that was absent from the physical world, or an imaginary object, or an object of memory—an object that human beings are still able to think about even in its inexistence. The early Husserl's phenomenology promises to grasp the epideictic truth of objects as ideality, a truth without any presupposition. Husserl's "pure seeing" is different from the "natural seeing" of the nave realists. For Husserl, pure seeing means to grasp objects in their eideticity in consciousness; natural seeing is a gaze that doesn't question what is seen. It is also different from the multiple "points of view" of relativism and is a matter of seeing to go beyond the transcendence of objects by bringing them to the immanence of consciousness. To do this, Husserl proposes the *epoché,* or bracketing of the ego from all presupposition, and starting from the pure ego.[30] Phenomenology is the description of the pure ego's experience of objects through intentionality.

Let's take the view in *Formal and Transcendental Logic,* where Husserl questioned the notion of objectivity taken for granted by logicians by passing from a formal logic to a transcendental logic. Objectivity, for Husserl, has its foundation in subjectivity, for example, counting and combining;[31] hence Husserl reproaches the logicians for a lack of "a serious philosophic exploration of the origin of the concepts fundamental to formal mathematics." Husserl classifies formal logic as "formal apophantic" and "formal ontology" (this already differs from Smith's classification). One has to bear in mind that *Formal and Transcendental Logic* tends to be a programmatic outline of Husserl's project; it also reads as Husserl's self-reflection of such a program, hence we can see that he moves back and forth all the time. The formal apophantic concerns three levels, namely, pure morphology of judgments, logic of consequence (or of noncontradiction), and logic of truth.[32] We can also say that it concerns meanings of syntactical operation, which Husserl calls the "categories of signification," and which belongs to the "region of meanings" as distinct from the object.[33] In general, formal apophantics deals with "syntactical categories," whereas formal ontology deals with "objective multiplicities." Husserl tries to point out in *Formal and Transcendental Logic* that formal logic since Plato onward has been developed into a deductive system and attends its maturity in Leibniz's concept of the *mathesis universalis,* which he identifies with formal logic. Husserl's task, as Suzanne Bachelard clearly stated in her *A Study of Husserl's Formal and Transcendental Logic,* is to go beyond the formal criticism of cognition, meaning *mathesis universalis,* to a transcendental criticism, only which can "truly set up a universal theory of science, for it is the criticism of the intentional life that itself 'constitutes' provinces and theories."[34] Husserl's strategy was first to question his own preceding separation of formal logic as both apophantic logic and formal ontology:

> Can a formal ontology be at all distinguished from an apophantic logic, if only as the latter's correlate, yielded by a mere change of focus from propositions to objects? . . . But what if we wished to determine the table purely by concepts belonging to "formal ontology," like object, property, relationship, and plurality—that is to say variational concepts pertaining to anything-whatever? Are these something other than "categorial" concepts—that is: concepts that have accrued through merely looking abstractively at the syntactical forms in which the object is apprehended at varying levels in syntactical actions, actions of judgement?[35]

Husserl is binding apophantic logic to formal ontology, because to apprehend the object on one hand one will need a formal ontology specifying the relations between the state of affairs, the part and the whole, and on the other hand, one should also be able to derive a logical method than maintains its consistency, so that both disciplines "stand in perfect correlation throughout and, for that reason, must be held to be a single science."[36] Objectivity is always based on modes of categorical forms, and the phenomenological method is a science that attempts to attend this categorial objectivity. In this sense, logic and ontology cannot be separated, because the validity of a judgment (consider the copula s = P) demands something other than itself. The move from a formal logic to a transcendental logic is to establish a phenomenological foundation of the "formal," which is intentionally formal (subjective) but not extensionally formal (symbols), and hence "transcends objective logic by integrating it into a logic able to attain a full understanding of itself."[37] In the research of formal ontologies, the phenomenological method is rarely discussed, and the central concept that Husserl calls sense-investigation *(Besinnung),* based on the two poles of the consciousness and its object, seems to have been forgotten or ignored. Sense-investigation bases on the two poles, namely, the consciousness and its object; and in the face of confusions of manner of the giveneness of object as well as the lack of clarity of judgment, the consciousness demands a sense-explication *(Sinnauslegung)* process as a dialectics between the evidence and fulfillment of meanings.[38] Guarino's definition of formal ontology as "a logical theory accounting for the intended meaning of a formal vocabulary" carries a true Husserlian spirit; it also bypasses the transcendental critique that distinguishes Husserl from other logicians, such as Frege and Carnap. We elaborate on this question in chapter 5, with a focus on Husserl's later work *Experience and Judgement.* Husserl's phenomenology is not an easy subject to explain, hence in the rest of this chapter, we direct our focus to certain of his concepts, such as intentionality, and objects that are relevant to our investigation.

Machine Intentionality and Computational Ontology

Before continuing our discussion of Husserl's formal ontology and its intentional economy, I would like to introduce here the work of Brian Cantwell Smith. Cantwell Smith is not one of those ontologists in the camp of Barry Smith; instead, I think that more than anyone else, Cantwell Smith has integrated Husserl's phenomenological approach into the development of formal ontology. Cantwell Smith is also a philosopher of computation, whose work is concrete and speculative, while remaining ignored by the philosophy community. The introduction of Cantwell Smith here serves first as an opportunity to return to the question of syntax and semantics, which we characterized as a way to think about the origins of digital objects; second as a chance to elaborate on the concept of ontology, because Cantwell Smith's work is a critique of the naive practices found in computer science, which has rarely taken ontology seriously; and last by reading Cantwell Smith and Husserl together, which allows us to move from a human intentionality to one that can also be addressed to machines. It is to find a new common ground between the formal logic and transcendental logic, hence preparing for what I try to sketch in chapter 5, a transductive logic.

At first glance, ontologies and semantics are not really two wholly separate subjects. So far, we have given an account of what ontologies mean for humans, but what do these objects mean to machines? We have seen that digital objects are composed of formal and structural relations. Is this only meaningful to their creators and users? Or, in the process of implementation, have we already assumed them to be objects for machines? That is to say, have we already granted this intuitive power to machines? It is certain that at the level of circuitry, digital objects are only voltage differences. But do machines experience them as "objects" in their operations? In the preceding exposition, we have to some extent assumed that machines are merely "syntactic." Formal ontologies and knowledge representations discussed thus far are only concerned with representations or social conventions,[39] that is, they are human-centric: I, the ontologist, represent the world as such and take this representation to be objective. But ontologies are more than representations. Kant already shows this in his *Critique of Pure Reason*: categories are productive *(erzeugend)*; they work as a function that creates the concept of the object or the object in the mind together with other faculties. The mind-dependent objects are secondary objects, but objects nevertheless. Some neuroscientists (especially in the camp of neurodynamics) may question whether there is really conceptual representation in the mind, but in the machines, it is undeniable. They are not only conceptual but also material and subject to calculation and interaction.

This issue is also related to the "syntactic" machine, which already suggested that machines are not able to take account of "objects" as demonstrated in Searle's Chinese Room thought experiment. We have to ask, what does "thinking" mean here? And what is the "semantic" of an ontology (semantic web)? When Berners-Lee talked about the global mind and the semantic web, did he only mean it analogically? We have to remind ourselves that both thinking and semantics here refer to a specific understanding of human cognition. The idea of the syntactic machine is in itself a denial of the idea of the intentionality of machines. This challenge can be understood as implying that (1) because computation is both syntactic and formal, there is no semantics; (2) intentionality has fundamentally to do with semantics; and (3) therefore computation is not at all intentional.[40] From the outset, engineers have assigned logical statements to computers, while the computers themselves have no sense of their meanings at all. One can therefore argue that if computers understood semantics, they would be derivative but not original semantics. As Brian Cantwell Smith critically puts it,

> many people have argued that the semantics of computational systems is intrinsically derivative or attributed—i.e., of the sort that books and signs have, in the sense of being ascribed by outside observers or users—as opposed to that of human thought and language, which in contrast is assumed to be original or authentic. I am dubious about the ultimate utility (and sharpness) of this distinction and also about its applicability to computers.[41]

Cantwell Smith argues that we can actually think about a theory of intentionality on top of a theory of computation. He proposes that, first, one has to ask, what is semantics, or more precisely, what are those semantics that philosophers claim a machine doesn't have?—because for him, empirically, a machine doesn't work on mere representations and symbols. Second, one has to ask whether intention has necessarily and only to do with semantics, and if so, again, what kind? His own argument can be summarized as, first, that derivativeness is the origin of computation and, second, that derivative semantics is still real semantics. He insists that symbols must have semantics—"i.e., have an actual interpretation, be interpretable, whatever—in order for there to be something substantive for their formal manipulation to proceed independently of. Without a semantic character to be kept crucially in the wings, the formal symbol manipulation construal would collapse in vacuity."[42] This entails that there is some sort of intentionality, or at least that there are cognitive activities of some kind, within computers. In other words, instead of being pure symbols or semantics of natural languages, there is something else in the operations of objects inside machines.

For Cantwell Smith, computational data are like sense data and should be treated as *flux of consciousness,* and computation (as well as cognition) acts on this flux to categorically create the objective form out of it. Here we can see an important link between metadata, metadata schemes, and digital objects. Under the intention of algorithms, metadata schemes act as categories and create objective forms from the flux of data and hence present us with digital objects. Cantwell Smith's speculative project is to develop a foundational theory for computation grounded on objects, which he calls "successor metaphysics" and the "metaphysics of presence." Semantics of machines can be revealed when this approach toward ontologies is well clarified. Smith also admits the problem of the uncertainty of knowledge representation and argues that what is at stake is not only the ontology of computation but also the nature of ontology itself. Our ontologies of the world are closely related to our commitment to the world; thus the engineer's understanding of a medical ontology is different from that of a doctor, because they have different commitments to and engagements with the world with which they are dealing. To expose this problem within the understanding of ontology in computing, Cantwell Smith proposes to go back to the origin of objects, that is, to the question of how organisms perceive things. He then proceeds to how this theory can be applied to the construction of ontologies in machines:

> There is no way to proceed on the overall project, of developing a comprehensive theory of computation that meets both the empirical and conceptual criteria, except by taking on metaphysics and ontology directly.[43]

This means that to look into the matter, one should reexamine the concept of representation. Cantwell Smith's project proposed that it is necessary to think about objects by situating them in their own world, in the sense that he calls "foundational."[44] According to Cantwell Smith, our representations of the world, as well as our ontological commitments to the world, originate from this registration, which also underlies the possibility of computation. In the end, Cantwell Smith states that "the distinction between representation and ontology is indefinite, vague, unstable, etc.,"[45] because

> one cannot press on the *whats,* the *whethers,* the *whys,* and the wherefores of representation without facing up to the ontological and metaphysical commitments of the people who use them to register. And one cannot do these things because representational practices and metaphysical commitments are not independent phenomena.[46]

He has developed a theory of registration, referring to the correlation between the subject's perception and the object's presence. To Cantwell Smith, one has to think about the origin of objects, and to approach this foundation is necessarily a task of metaphysics. He situates registration as the middle term lying between representation and ontology, the link between the "what is it?" of ontology and the "how is it represented?" of epistemology. This is also the intentional correlation between the subject and the objects. Moreover, the registration process reveals that both computer scientists and machines have to understand ontology as dynamics of registration rather than static categories. Cantwell Smith's project, to my understanding, has two effects: first, he reproaches computer scientists for paying little attention to ontology and intentionality, and hence remaining dogmatic in constructing ontologies, and second, he demonstrates how a subject–object correlation approach to ontologies can be thought not only for humans but also for machines. He devotes two chapters to the idea of registration, the first of which we will discuss here as the most relevant to our project. This discussion of registration will also lead us to recognize the similarity between the approach of Cantwell Smith and Husserl's phenomenological method, though they use different vocabularies. I hope that through the following comparison, we can establish a solid link between the phenomenological inquiries of the twentieth century and the philosophy of computation that has always been associated with analytic philosophy. Cantwell Smith's project "the origin of objects" coincides with phenomenology's slogan "back to things themselves." Indeed, Cantwell Smith's book *On the Origin of Objects* is striking for the impressive way it integrates some threads of the different phenomenologies of Husserl and Heidegger, for example, the former's understanding of cognition and the latter's discussion of being-in-the-world.

Cantwell Smith on the Origin of Objects

Cantwell Smith analyzes registration through the interaction between the proto-subjective region (s-region) and the proto-objective region (o-region). The idea of registration involves a process with three steps referred to as "tracking," "separation," and "stabilization." Taking Smith's example, let's imagine that a frog sees a fly that is flying in front of it and constantly in movement. The frog detects the presence of the fly, but without paying attention. This is the Husserlian concept of *pre-predication,* as that which happens before the subject's intentional act. Then the fly flies away at the sight of the frog; this sudden change demands a retraction, to notice the flying away of the fly. Now the frog starts registering the fly to have an idea about it. This is what Husserl calls "explication": the intentional act that acts like a camera lens, able to zoom in on a certain aspect of the fly. The subject is able to explicate what is present through *ideation* of the object by modifying what Husserl calls the "horizon." Smith expresses it in this way:

> Taking an object as an individual means gathering up an extended region of the flux and treating it as a unity. This implies that the subject must stand in relation to what it is as a unity. This implies that the subject must stand in relation to what is the same or in common across the constitutive spatial and temporal region, and by the same token must ignore or set aside the multitudes of internal variation attendant to its parts, or across its life.[47]

This compares with Husserl's phenomenological approach, whereby he takes consciousness as a flux and sees the responsibility of the mind as being to unify this flux to form a unity of the object as such. The phenomenological reduction is an attempt to produce the idealization of the object through the *ideation* of this unity.[48] For example, when I see a house from the side and afterward from the back, I know that it is the same house. Even if, one day, part of the wall falls down, I can still recognize it as the same house. The absence of the house doesn't destroy this idea at all but rather confirms the idea as such. Cantwell Smith continues by saying that this separation is important, since things are present because of their absence. In Cantwell Smith's own language, the s-region must be separated from the o-region in the coupling, and the s-region will be able to stabilize through this detachment. This absence is the condition for retention, and this retention brings the object into presence:

> To put it more carefully: in order to be present, ontologically—i.e., in order to be materially present—an object must also be (at least partially) absent, metaphysically, in the sense of being partly out of effective reach.[49]

This coincides with Husserl's view that absence or inexistence is precisely the theoretical foundation of intentionality. Intentionality designates the ability of the ego to correlate the world given to him, or in Husserl's own refrain, "consciousness is to be conscious of something." A further example can be illustrated with Husserl's idea of the time-consciousness of the temporal-object *(Zeitobjekt)*,[50] which is the interplay between what he calls primary retention, secondary retention, and protention. Primary retention is the impression that is retained in past immediacies. The past immediacies can be further retained and collected in memory, which is the secondary retention.[51] The retentions condition protention, which is both anticipation and projection.

Actually, Cantwell Smith drew a parallel between the correlation between subject and object through the process of stabilization and Husserl's distinction between the temporality of perception and the perception of temporality (also between Kant's consciousness of unity and unity of consciousness);[52] the first notion refers to the ability to identify that the fly that flies from one side to another is the same fly when it is stationary, whereas the second refers to the ability to unify different perceptions of "the" fly into the concept of "a" fly. In this manner, Smith's registration can be conceived as similar to Husserl's concern with a cognitive mechanism (temporality of perception) rather than a psychological one (perception of temporality). Registration is important for Cantwell Smith because it is the condition in which the subject is able to participate in and represent the world.

We can see here that the two correlations, (1) syntax–categories and (2) semantics–meanings, cannot be easily separated. But astonishingly, in the bibliography of his book, there is no reference to Husserl's works at all.[53] This is not at all to criticize Smith's project; in fact, it is here through the work of Cantwell Smith that we can establish such an intimacy between phenomenology and computation, which also presents us with a new kind of speculative reason. Nevertheless, there is still a difference between Husserl and Cantwell Smith, in that Cantwell Smith is comparatively *more* concerned with going "back to objects" than Husserl. Cantwell Smith pays more attention to references, whereas Husserl pays more attention to judgments; that is to say, for Husserl, it is always the subject that determines the unity of the objects, whereas for Cantwell Smith, the individuality is always a constituted unity of references. The affinity between Cantwell Smith and Husserl shows a line of inquiry into the subject matter through a speculative phenomenological method that also has two practical implications.

First, computation has been dominated by logic and mathematics; even for philosophers working on formal ontology, only *part* of the early Husserl has been taken into account, while the later Husserl is denounced as being a transcendental idealist.[54] In this case, we can even say that Cantwell Smith's critique of dogmatic computational ontology bears such a similarity to early Husserl's phenomenology that it was ignored in computer science. Husserl's pure seeing was naturalized by cognitive science, in what is known as the movement of the "naturalization of phenomenology" in the late twentieth century.[55] This pure seeing has become the foundation of computation that Cantwell Smith criticized. Formal ontology is indebted to this pure seeing or *Wesenserschauung*, by which the digital objects gain their ideal and typological forms. The ideality of the digital objects completes the cognitive process of the computation system as a whole. In chapter 5, we will see that the later Husserl actually went in almost the opposite direction to the early Husserl; his critique of formalization as "technization"[56] offers a new perspective from which to question the objectivity of an object. Second, this affinity with the Husserlian phenomenology or intentionality also opens up to us the whole subsequent century of phenomenological inquiry into the existence of objects and intentionality, however, this time also with machines. This tradition, in the philosophy of Martin Heidegger, Alfred Schutz, and others, has been able to provide alternative understandings and inspirations for computing as well as computational culture. Indeed, the shift from the early Husserl to the late Husserl and the divergence of Heidegger from the early Husserl are significant for our investigation.

From Ontologies to Fundamental Ontology

The philosopher and historian of philosophy Étienne Gilson points out that the word *ontology* is actually a modern term—it first appears in the seventeenth century.[57] The emergence of the word also corresponds to a new understanding of the relation between essence and existence of being. According to Gilson, the subject of medieval metaphysics was defined to study the question of Being as Being, formulated by Avicenna and then endorsed by the theologists of the Latin West. It won't be our task to elaborate on it, as Gilson and Heidegger have already done excellent studies on the history of ontology, but it is important to notice that the modern concept of ontology originated from a rupture of the perceptions of the relation between essence and existence. In Avicenna's doctrine, existence is a predicate of essence. Thomas Aquinas took up the same proposition but also departs from there. We can probably say that the way existence is added to essence is different in the two doctrines. In Aquinas, it is in the act of the creation that "the Being of the creator creates freely a being which, as the act of the essence, constitutes an actually existing being."[58] For Avicenna, "the existence of the finite essence is therefore not an act that the creation confers on it . . . but a concomitant that ensues from it, or accompanies it."[59] Duns Scotus would later argue against Avicenna and Aquinas that there is no real distinction between being and existence. What this history of metaphysics adds to our discussion is that the question of Being as Being is not homogenous at all, and indeed, it defines the general direction of occidental thought. The emergence of ontology, which is used quite freely today, more or less came out of the discussion on the relation between essence and existence.

In the chapter *Aux origines de l'ontologie,* Gilson argued that Francisco Suárez (1548—1617) played an important role in preparing the conception of ontology in modern philosophy. According to Suárez, *ens* is at the same time a present participle and a nom, however, *ens* comes from *sum,* which always signifies actual existence. Hence Suárez tends to understand *ens* as a noun that designates essence, the aptitude of existing.[60] In such a formulation, being becomes the question of essence, and existence expresses the aptitude of essence to exist. Gilson observes that for such an ontology, essence exhausts the richness of the being, and "by consequence it is legitimate and useful to demonstrate that existence cannot be added to the real essence like an actuality of another order."[61] The essentialization of being in the school of Suárez prepares being as a scientific subject in which existence is not essential. This line of thought was continued in the work of Descartes, who was a student of Suárez's student and also his disciple.

We will turn to Heidegger here, because I think Heidegger's critique of the Cartesian tradition that removed existence from the question of Being as Being is probably the most powerful one. Heidegger's task was to restore the question of Being from essentialization, through what he terms in *Being and Time* the fundamental ontology. In comparison, we also have Heidegger's fundamental ontology, which can be used as the basis for a critique of Cantwell Smith's concept of a foundational metaphysics, as well as others employed in AI and formal ontology research. Fundamental ontology triumphed by announcing the end of phenomenology[62] and denouncing the existence of a pure ego. Though he didn't notice that the pure ego is implemented in cybernetic machines, Heidegger's antithesis of modern science and technology is actually a testimony against this rigorous foundation of all sciences. If we can generalize that Husserlian phenomenology is a "rigorous science" with regard to entities *(Seiendes),* then the Heideggerian phenomenology is a "fundamental ontology" aiming to tackle the question of Being *(Seinsfrage)* to provide a ground that is not epistemological but the formal structure of beings as a whole (*Dasein* analytics). Traditional ontologies are characterized by a gaze that is always directed from the subject to the object. The validity of the object depends on the action "I think," and the question is, what if the Cartesian ego itself is the Achilles' heel of modern metaphysics? Heidegger's approach starts by trying to determine that which is without presupposition and proposes that we are always "being-in-the-world." Truth is not what is grasped by human subjects; rather, it must come from beings themselves.

To follow this path, Heidegger proposes to destroy all ontologies. This ambition is intrinsic to Heidegger's inquiry into the meaning of Being, which he found to have been unanswered in the history of philosophy. To think Being apart from beings, which are commonly understood in terms of "subject-predicates," Heidegger directly confronts Descartes, as well as Edmund Husserl, because Husserl ultimately found his phenomenology in Descartes's *res cogito.*[63] Heidegger's critique points to a fundamental mistake at the foundation of Cartesian ontology. Descartes distinguished *res cogito* from *res corporea,* or, roughly, "spirit" and "nature." The substance of *res corporea* can only be grasped through extensions, termed *res extensa.* This is not saying that substance is *res extensa,* for substance itself is difficult to address because it doesn't belong to anything other than itself. So substance can only be approached through *res extensa,* that is, in terms of width, length, color, and so on. On the other hand, for Descartes, the word *substance* is inappropriate for describing God, so that in considering definitions such as "God is" and "the world is," the "is" will be required to have different senses. Otherwise, being would be univocal, and this would imply that "what is created would be viewed as if it were uncreated, or the uncreated would be reduced to the status of something created."[64] So the meaning of being remains unanswered in the radical separation of God, the I, and the world, and the substance of beings in the world can only be answered in terms of *res extensa.* As a result, "something ontical is made to underlie the ontological, the expression *'substantia'* functions sometimes with a signification which is ontological, sometimes with one which is ontical, but mostly with one which is hazily ontico-ontological."[65] This foundation of Descartes's ontology, according to Heidegger, is a fault that misses the phenomenality of the ready-to-hand:

> [Descartes's] interpretation and the foundations on which it is based have led him to pass over both the phenomenon of the world and the Being of those entities within-the-world which are proximally ready-to-hand.[66]

This misinterpretation of being as *res extensa* leads to the problem that beings in the world are equated with the present-at-hand. Heidegger's thesis aims to make the phenomenon of the ready-to-hand a challenge to Descartes's ontological foundation of the present-at-hand. In the case of the hammer, *Dasein* doesn't need a representation of the hammer as a collection of attributes when it uses it to hit the nail. The *res extensa* of the hammer retreats into the background as if it were not important. So the totality of the Cartesian interpretation of objects doesn't hold anymore—yet the Cartesian method is so influential that it penetrates into the understanding of *Dasein* as well:

> The idea of Being as permanent present-at-hand not only gives Descartes a motive for identifying entities within-the-world with the world in general, and for providing so extreme a definition of their Being; it also keeps him from bringing *Dasein*'s way of behaving into view in a manner which is ontologically appropriate. . . . He takes the Being of *"Dasein"* (to whose basic constitution Being-in-the-world belongs) in the very same way as he takes the Being of the res extensa—namely the substance.[67]

Heidegger's critique totally rejects the Cartesian method of taking things as *res extensa.* This critique is employed by the American philosopher Hubert Dreyfus in his rejection of knowledge representation as used in the Good Old Fashioned AI (GOFAI).[68] If AI follows the Cartesian method, then its foundation will, according to this argument, obviously be flawed. There is another point that is somewhat obscure in these critiques. As Heiddegger says, Cartesian ontology can only think about things within the definite realm of the entities themselves. That is to say, being doesn't signify other things, but its substance. Heidegger declared that in the Cartesian method, or in ontologies in general in modern metaphysics, questions have only been posed concerning beings, but not Being.

Heidegger and the Origin of *Gestell*

The distinction between Being and beings constitutes what Heidegger calls the ontological difference *(ontologische Differenz).* The ontological difference also manifests in the differentiation between object *(Gegenstand)* and thing *(Ding).* The German word for object, *Gegenstand,* is Christian Wolff's translation from the Latin *ens,* which in turn is the subject of ontology.[69] In so doing, Wolff follows Suárez and takes essence instead of existence as the "primary in being and the source of all its operations."[70] Heidegger shares Gilson's critique, because for both of them, to inquire into the question of existence, it is necessary to get out of such a framework of ontology. The translation of *ens* as *Gegenstand* for Heidegger characterizes the problematic of ontology, because it also literally refers to the oppositional relation between human beings and objects: standing *(stehen)* against *(gegen).* Objects correspond to an epistemological understanding of things, or to their presence. Things, for Heidegger, constitute the existential structure of being itself, which goes far beyond its appearance and functionality, being thematized as formal knowledge. Heidegger's critique of objects starts from his understanding of the constitution of things or nature. He asked why Western metaphysics is called metaphysics and answered that this came about because it is essentially grounded in physics, or to use the Greek word, *physis* (φύσις).[71] The history of metaphysics is no less the history of the determination of Being and truth. Heidegger understands the idea of truth *(Aletheia)* as the presencing of presence *(Anwesen)* in pre-Socratic Greek thought. This is to be distinguished from another mode of presence, which is simply something standing in the present "against" us. Heidegger wants to understand the original meaning of presence as something approaching and, indeed, reaching a human being in an ecstatic sense.[72] This way of grasping things as presence implies a process by which things lose their temporal dimension and are prepared for their appropriation by hylomorphism. The separation of form and matter, conceived by Aristotle in terms of the process by which a statue is produced,[73] at the same time separates *theoria* from *praxis* and *poiesis. Theoria* as productive metaphysics identifies *eidos* with *logos* and transmutes itself from *vita activa* into *vita contemplativa*.[74] The misconception of things led to a mistaken understanding of production, as thinking expressed in acting. This misconception was amplified in the shift from technics to technologies. The original sense of *technē* as related to *theoria, praxis,* and *poiesis* was also lost in the transformation of knowledge. In *The Question Concerning Technology* (1954), Heidegger tried to identify a break in the history of technology, which began in the fifteenth century, splitting *technē* from modern science and technology. *Technē,* according to Heidegger, in ancient Greek thought is also *poiesis,* a process of bringing forth. Heidegger cites the four causes of Aristotle:

> (1) the *causa materialis,* the material, the matter out of which, for example, a silver chalice is made; (2) the *causa formalis,* the form, the shape into which the material enters; (3) the *causa finalis,* the end, for example, the sacrificial rite in relation to which the chalice required is determined as to its form and matter; (4) the *causa efficiens,* which brings about the effect that is the finished, actual chalice, in this instance, the silversmith.[75]

The first three causes are material correlations, which prepare the way for the fourth cause. For example, the chalice is made of silver; its form is indebted to the very nature of silver itself and is also responsible for the particular setting of the rite. We can rephrase these three causes as matter, form, and function. To give another example, that of making a knife, we need the material, which is metal, and the form of a knife, and we make it according to its function, for example, fighting or chopping or opening letters. The three causes apparently correspond to the commonsense view of artifact making. The fourth cause, *causa efficiens,* is not well interpreted but, according to Heidegger, is not really the silversmith. The silversmith is the one who considers according to the first three causes, but he cannot be the fourth cause. Heidegger writes,

> To consider carefully *[überlegen]* is in Greek *legein,* logos. *Legein* is rooted in *apophainesthai,* to bring forward into appearance[76]

This bringing forward into presence is *poiesis* in Greek, or *hervorbringen* in German. Heidegger continues, "Bringing forth comes to pass only in so far as something concealed comes into unconcealment. This coming rests and moves freely within what we call revealing *(das Entbergen)*. The Greek has the word *Aletheia* for revealing." The final causality bears the significance of the possibility of clearing or lighting *(Lichtung)*, in which the relation between humans and things comes into the light. The problem of modern technology, according to Heidegger, is the result of that which he refers to using the concept of the "standing reserve" *(Bestand)*. A standing reserve denotes a thing defined by the fact that it can be ordered and calculated, where even space and time are understood to be mere measurements. The standing reserve is necessarily the foundation of modern technology, and it is no surprise that it has its foundation in the concept of *Gegenstand*. The thinking intrinsic to this mode of production is termed *Gestell* by Heidegger, for whom *Gestell* replaces *technē* as the essence of modern technoscience. *Gestell* poses violence toward the closure of the world. The revival of things requires a return to the question of the world, to retrieve the world from its objectification in being restricted to logical thinking.

Detachment of Objects and Attachment to the World

Heidegger's fundamental ontology seems to be something that Cantwell Smith's foundational metaphysics cannot reach, and this allows us to put them both into question. We can probably say that for Cantwell Smith and for Husserl, the inquiry is primarily to do with the present-at-hand, whereas for Heidegger, it is necessary to go further than this mode of knowing. How, then, can we understand this difference? We can probably say that there are different orders of magnitude when we approach the present-at-hand and the ready-to-hand. The present-at-hand is closely related to forms, because to conceptualize an object, to give it the most general form, demands a gaze that extracts its predicates. This is clear when we think of the coherence between Aristotle's *Categories* and his hylomorphism. The question that remains unclear, and crucially needs to be interrogated, is, what are the relations between these two orders of magnitude? One way of looking at this would probably be to claim that they function in terms of something like Wittgenstein's language games, which attach the languaging faculty to the world and daily practices. I would like to move from here to a discussion of detachment, which is both a detachment of the thought from the world and a detachment of the object from the thought. These two detachments meet each other halfway. A comparison between Heidegger and Simondon on the detachment of technical objects will clarify this.

For Heidegger, the way of understanding objects through predication is no longer simply a "point of view" but the totality of thinking originated by modern metaphysics. In his 1938 essay "The Age of World Picture," Heidegger describes this totality as "world picture" *(Weltbild).* To Heidegger, what characterizes the world picture is not the picture of the world but the world "conceived and grasped as a picture." Heidegger wrote, "The fundamental event of the modern age is the conquest of the world as picture. The word 'picture' *(Bild)* now means the structured image *(Gebild)* that is the creature of man's producing which represents and sets before."[77] The technologies thus invented presuppose this thinking as world picture and treat its objects of operation as graspable pictures. Thought is detached from the world, because the world is only a picture that the mind can contemplate.

Simondon, conversely, sees a detachment of thoughts from objects. In *Imagination et invention,* Simondon showed how the cycle of image (perception–mental image–symbols) drives invention. But invention is not limited to thoughts; actually, it detaches itself from thoughts when it is realized as a technical object. We can even observe that technical objects don't exclusively follow the paths they were supposed to. We can probably describe this in terms of two detachments. First, the concretization of technical objects brings to light some new functions that weren't part of the design. Simondon calls these overabundant functions *(fonctions surabondantes).*[78] This realization in material terms always exceeds the aim of invention, which is originally to solve a problem:

> It will be partially wrong to say that invention is made to achieve an aim, to realize an effect totally predicted in advance. Invention is initiated concerning a problem; but the effects of invention are more than *[dépassent]* just resolving the problem.[79]

Simondon compared this detachment as difference with Marx's concept of surplus value. These surpluses accumulate and modify the milieu according to their own logic. The second detachment is when the objects reach the hands of their users. These technical objects are then reinscribed in the daily lives of users and produce new images and aesthetics, which reenter the cycle of images. There is a certain tension between Heidegger's emphasis on the totality of thoughts and Simondon's conception of the detachment of objects that cannot be fully grasped by thoughts. We can also see that there are two types of amplification in two cycles, namely, the cycle of thoughts and the cycle of images as invention. One amplifies thinking as the totality of a system; the other amplifies the power of imagination in invention. It would be difficult to make a simple judgment, saying which is wrong and which is right, because there are different causalities that cannot be viewed as mutually exclusive. If we understand these differences as differences of orders of magnitude, then we can probably resolve the question with a third term. We may be able to approach it from what Heidegger calls being-in-the-world, as this also resonates in some ways with Simondon's concept of detachment, partly because objects in the world are always beyond human contemplation.

It may make sense to start the rest of our analysis at the mid—the waypoint where the two detachments meet—which is also a third term whereby two orders of magnitude are overcome. One of the most characteristic examples of the ready-to-hand in *Being and Time* is the use of a hammer. We use a hammer without taking account of the ideality of its appearance and without making it a theme of cognition; rather, we just *use* it. Humans are not actors who merely observe. In this sense, one can claim that for Heidegger, everything can be a technical object, or what Graham Harman reframes as a "tool-being."[80] What we call here Heidegger's "technical objects" are different from Simondon's technical objects, which are more to do with technical knowledge (almost the opposite of the technical object). Heidegger's technical objects concern the object's modes of being, which are accessible through *Dasein* in the world. The world, as Heidegger proposes, is the matrix of relations *(Bezugszusammenhang)*.[81] The technical object in the world is also configured by the matrix of relations, which in turn locates the *da* of *Dasein* by disclosing the meaningfulness *(Bedeutung)* situationally. The fundamental question is, does the matrix of relations change in different technological systems/worlds? And how does this relate to Simondon's analysis of relations in technical ensembles and between human and technical objects? This remains our task in this book: to produce a "quantum leap" between these two orders of magnitude. Indeed, throughout the rest of this book, I will not situate Simondon and Heidegger in opposition to each other but rather will consider them as representatives of different orders of magnitudes. It is easy to come to the conclusion that Heidegger's critique of technology originates in an understanding of objects, whereas for Simondon, technology is no less than the evolution of objects. In fact, Heidegger and Simondon both want to move humans away from the conception of themselves as the center of the world.

The two approaches to ontology, or, we can say, the two main approaches to the origins of objects—one through the object's formal structures and functionality (ontology), the other through the thing's self-manifestation in everyday life (Ontology)—must work together and guide our investigation. If individualization corresponds to the evolution of ontologies and logic, then individuation corresponds to Ontology—a theory of being-in-the-world. The individuation of the digital object has to be situated not only in the structure of the object itself but also in its exterior surroundings, which constitute partly its associated milieu. The associated milieux are only possible when we take ontology into consideration and hence are able to understand individuation. Posing the question in this way, ontology is necessarily technical. And Ontology, if it intends to grasp the modes of being of the thing itself, cannot do without its technical nature. I would like to reconcile the opposition between these two notions of ontologies as well as the opposition between syntax and semantics through a third: that of relations. Chapter 3 offers an interpretation of the *Bezugszusammenhang* of digital objects by retrieving the concept of relation in *Being and Time* and its conception in mathematics and information science. Chapter 4 describes technological evolution according to what I call *interobjective relations* and considers how time can be articulated in a technical system.

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· Part II ·

Relations

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· CHAPTER 3 ·

The Space of Networks

In chapter 1 of this book, I discussed the concept of digital objects as a way of formulating a technical lineage from GSML to the semantic web by following Simondon's concept of *individualization,* and in chapter 2 I traced the origins of objects in the theories of Cantwell Smith, Husserl, and Heidegger to understand the complexity within the concept itself. In this chapter, I propose to understand *individuation* by retrieving and reinterpreting the notion of relation through reading Heidegger and Simondon as well as to develop a genealogy from Aristotle through medieval philosophy, Leibniz, Hume, Kant, Husserl, and Russell to recent computational technologies. If we can say that individualization implies a progression of form, then individuation subsequently accounts for a transformation in the operation of relations and structures. Throughout our analysis so far, we have tried to approach the digital object from its form (as in the metadata scheme). Metadata determines the object and its beyond, through what I would categorize as "relations." The concept of relation has from medieval philosophy until recently been largely underdiscussed since, despite the fact that it has always been present and has haunted many philosophers. Aristotle cast a lot of doubt over it while he was determining his categories. This fueled a tendency throughout discussion among medieval philosophers, who argued about whether relations are able to be reduced to external accidents pertaining to the substance or whether relations are monadic properties of a sui generis type. Throughout this chapter, I want to examine the question of "relation" in the context of Heidegger's *Sein und Zeit.* Then, in chapter 4, I develop the concept "interobjectivity" as a parallel reading of Simondon's speculative history of technology in *Du mode d'existence des objets techniques* to understand the technical progress of the informational age, especially regarding the concept of a "technical system."

Ready-to-Hand versus Present-at-Hand

Where is the digital object? If we take the computer in front of me as an example, than the answer is simple—I point to the machine and say, "It is there!" The machine itself occupies space; it informs the user of its existence via its appearance. The occupied space is both measurable and calculable, being amenable to what Kant would call a "pure intuition"—allowing the object to be perceived. The question subsequently becomes more complicated if we should ask, "What is the space of a digital object such as a Facebook profile page or a picture on Flickr?" A digital object is on the screen, despite its appearance as a 3D object. But it does not extend into physical space, although it appears to "occupy space." We are able to interact with this "space" by using a mouse or by using a finger (if it is a touch screen device). There is a space that exists on the screen, which has been referred to as *cyberspace.* The "space" of cyberspace is only significant when we consider the appearance of an object, because we will subsequently ask, "Where is this object, and how does it appear to us?" This questioning moves us away from the Kantian understanding—because to Kant space is something to be occupied; it is intuited, but it is nevertheless physical. As Kant said, "if from your experiential concept of a body you gradually omit everything that is empirical in a body—the colour, the hardness or softness, the weight, even the impenetrability—there yet remains the space that was occupied by the body (which has now entirely vanished, and this space you cannot omit [from the concept])."[1] Kant attempted to demonstrate that the body occupies a space that does not simply vanish with the disappearance of the qualities (i.e., it cannot be omitted from the concept of a body itself).

Moreover, as long as the space of a "digital object" is not yet defined as a priori, we are unable to articulate the "cyberspace" in terms of the space that we inhabit/encounter when using a chair, a computer, or some other physical object. When the qualities of a digital object disappear—as when we delete them layer by layer within our computers—by the end we find there is no longer anything there. If we were to find something remaining, it would likely be some record or trace acknowledging that something did exist there previously or perhaps take the form of missing links and bugs generated during the course of its disappearance. Is the space of a digital object "thinkable"? This question also motivates us to investigate further the very concept of space itself. In *Being and Time,* Heidegger attempted to examine the question of space through a phenomenological approach, whereby one is to look beyond the mere appearance of objects themselves. Heidegger classifies objects into two categories: those that are "present-at-hand" *(Vorhandene)* and those that are "ready-to-hand" *(Zuhandene)*. These two concepts also correspond to ontological difference as two modes of existence of a technical object. These modes will be mentioned frequently throughout the subsequent chapters of this book, so we address them thoroughly in this section.

Present-at-hand refers to the mode of apprehending an object thematically and "standing against" it. These forms of objects are intended for scientific investigation. For an engineer, a digital object is no more than something present-at-hand. The form does not come from nothing, however, but from a thematic apprehension, as we already demonstrated in the first chapter. The present-at-hand is therefore determined by categories. The *ready-to-hand,* in contrast, corresponds to a completely different mode of existence of the object; it has its significance not in the theoretical seeing of the object but in what Heidegger calls "dealing" *(Umgang)*. This does not mean that there is no "seeing" of the object but that there is a different way of "seeing," which Heidegger calls "circumspection" *(Umsicht)*. We should note that "dealing" and "circumspection" share the same prefix *um-,* meaning "around" in German, as also found in *Umwelt,* "environment." So both modes point to tarrying (or "hanging around") somewhere. In "dealing," *Dasein* works with equipment as if she is at home—that is, having a sense of familiarity that Heidegger calls "concern" *(Besorgen)*. Again, we are able to identify another play of etymology here, whereby *Besorgen* comes from *Sorge* (translating into English as both "worry" and "care"). "Concern" constitutes a temporality in which *Dasein* is completely absorbed without any self-referential reflection. For example, when we use a hammer, we do not necessarily contemplate the hammer itself as an object; we simply use it as if the hammer will seek out the nail on its own:

> Being-in-the-world, according to our Interpretation hitherto, amounts to a non-thematic circumspective absorption in references or assignments constitutive for the readiness-to-hand of a totality of equipment. Any concern is already as it is, because of some familiarity with the world.[2]

We should also understand the significance of ready-to-hand as a challenge against the ignorance regarding the mode of existence of technical objects exhibited throughout the history of philosophy (as we discussed in the introduction). Heidegger's phenomenology is distinguished from Husserl's precisely in that Heidegger departs from the *eidos* of the technical object toward its actual modes of being. The phenomenological approach thereby becomes a concern, not with capturing the ideality of objects, but with *Dasein*'s being-in-the-worldness. This involves a changing of two fundamental concepts within phenomenology, namely, the phenomenological reduction and intentionality. In Part I, we saw that, together, the reduction and intentionality compose the essential method for attaining the apodeictic evidence of an object as per Husserl's phenomenology. In *The Basic Problems of Phenomenology,* Heidegger developed his own version:

> For us phenomenological reduction means leading phenomenological vision back from the apprehension of a being, whatever may be the character of that apprehension to the understanding of the being of this being.[3]

For Husserl, phenomenological reduction presupposes a transcendental reduction that demands a transcendental ego in a Cartesian sense. The ego is the pole from which intentionality is directed toward the object. And in being conscious of the ego's intentional movement, it is able to exclude all presupposition and irrelevant detail about the object from needing to be investigated. Heidegger's concern is not with the ego's reduction but rather with hermeneutic reflection on the being "in"; that is to say, instead of an act of distancing oneself from the object, his gesture is to start from the being from within. So in the Husserlian phenomenology, reduction is the condition of possibility of an investigation of intentionality. Intentionality, as a phenomenological method, presupposes the necessity of *distance,* whereas for Heidegger, such a distance must be eliminated to understand the world. Instead, Heidegger argues that intentionality must presuppose a "being-in":

> Intentionality is not an extant relation between an extant subject and an extant object but is constitutive for the relational character of the subject's comportment as such. As a structure of subject-comportment, it is not something immanent to the subject which would then need supplementation by a transcendence; instead transcendence hence intentionality, belongs to the nature of the entity that comports itself intentionally.[4]

Evidently both phenomenological reduction and intentionality for Heidegger have an ontological sense or relation to the world, not as an entity, but as significations. Therefore the mode of being of technical objects constitutes *Dasein*'s concernful being, occupying most parts of *Dasein*'s everyday life. However, *Dasein*'s tarrying with technical objects may break down, following their potential failure. The concernful mode will stop once *Dasein* is exposed to a defamiliarized environment. As broken equipment is transformed into something present-at-hand, *Dasein* acquires a sense of being uncanny. The concernful being of *Dasein* underlines the condition of possibility of a genuine experience of space (in contradistinction to the measurable entity of Cartesian coordination). This would mean that space is an "in," albeit not an entity that is merely observed. This being so, what would characterize this "in" in terms of both space and ready-to-hand?

Technical Objects, Signs, and Space

This inevitably leads us to consider Heidegger's interpretation of the totality of references *(Verweisungsganzheiten)* as the condition of possibility of the ready-to-handness of equipment. A technical object belongs to the "equipmental totality" of the in-order-to *(um zu)*. The "in order to" describes equipment's being-for something, which Heidegger also calls its reference *(Verweisung)*: thus when the hammer finds the nail through the activity of hammering, it "references" the nail, as that to which its being-for refers. Yet the reference is not a singular line from A to B but rather always signifies other references, for example, hammering signifies the reference of the nail and then the object we are working on, for example, a table. This is why he identifies a totality of references—because each is ultimately connected to, or "references," all the others. So the "in" must be assessed through an interpretation of reference.

The "in" also has another meaning, not that of "being in" but of the "in itself" *(an sich)*. Phenomenology's mission to go "back to things themselves" confronts Kant's idea of the thing-in-itself *(Ding an sich)* as a priori unknowable. For the philosophers of German idealism, such as Fichte, Schelling, and Hegel, this unknowable constituted a problem to be clarified and resolved. Instead of following this path, Husserl simply denounced the thing-in-itself as mysterious. He argued that a thing can always be known or understood within the cognitive capacity of humans, which is the purpose of the phenomenological method. Heidegger also proposed the in-itself as knowable but never understood it as being ontic knowledge; instead, he considered the thing-in-itself to be a matter of ontological knowledge. This knowledge, he argued, can only be attained through the interpretation of the ready-to-hand:

> As long as we take our orientation primarily and exclusively from the present-at-hand, the "in-itself" can by no means be ontologically clarified.[5]

The totality of reference is a theory of sign and signification. The ready-to-handness is not a property of the equipment but only becomes accessible from within the understanding of its reference to other entities that constitute *Dasein*'s concernful being. This is one aspect of hermeneutic logic, that there is always already something being presupposed. Circumspection is not knowledge, but rather one of the consequences of fore-knowledge: "it is in the 'there' before anyone has observed or ascertained it. It is itself inaccessible to circumspection, so far as circumspection is always directed towards entities."[6] I would like to take a departure here to present an understanding Heidegger's interpretation of signs in two ways: (1) to understand the sign structure as an important aspect of the *Umwelt,* which conditions *Dasein*'s everyday acts, and (2) to show that Heidegger also undermines the analysis of relations, subsequently advocating instead the *Vorstruktur* as an ambiguous unity of knowledge.

Heidegger's theory of the sign in *Being and Time* is a continuation of Husserl's discussion of "Indication and Expression" in *Logical Investigations,* conceived as "supplements to Husserl's investigation . . . the orientation there being toward principles."[7] The significance of Husserl's contribution will be further discussed and reinterpreted in chapter 5 of this book, but to introduce it briefly here, Husserl distinguishes two types of signification: marks/signs, on one hand, and expression, on the other. According to Husserl, signs signify through a passive association. Upon grasping the sign or mark, we do not thematize the sign itself, but rather we respond as if we have been programmed. Expressions are different from signs because they have meanings. The word "meaning" must be carefully interpreted here, as Husserl does not say that a sign has no signification *(Bedeutung)* but rather that the sign is something we instantly recognize without requiring a process of meaning explication and meaning fulfilment.[8] Heidegger's contribution seems to prioritize the indication as opposed to the expression, because the automatic and instant synthesis points to the ready-to-hand. We can see this in Heidegger's definition of a sign as

> not a thing which stands to another thing in the relationship of indicating; . . . [it is] rather an item of equipment which explicitly raises an equipmental whole into our circumspection so that together with it the worldly character of the available announces itself.[9]

Indication juxtaposes the equipmental whole, just as a reference from A to B connects to an entire network of relations. A sign loses itself within the concernful being as an entity, which cannot be defined without taking into account the whole background. The background (or the totality of reference) is the worldness of the world.[10] Hence Heidegger writes that "the relationship of the 'with . . . in . . .' shall be indicated by the term 'assignment' or 'reference.'"[11] By the same token, if we understand space as something present-at-hand, we will lose the ontological understanding of it. Heidegger argues that "space is not in the subject, nor is the world in space."[12] This statement constitutes a paradox: first as our perception of space is not a denial of reality, because the object is not solely in the mind but also in the world, and second in that space is not a container that contains reality—so that an object is therefore instantly somewhere in between being mind-dependent and mind-independent. This paradox produces two subsequent questions: What is the genuine relation between space and object? and What is the place of the human subject? The first question reapproaches the Kantian idea of space, because Kant emphasizes the fact that space cannot be seen merely as a container but is itself the a priori condition of understanding, which he calls the "pure intuition." The term "pure" for Kant means a priori, something that cannot be derived from empirical experience. Therefore space for Kant is both objective and subjective. Kant's question is, what is the condition of possibility that allows the objective (in the sense of being an object) to remain objective (in a scientific formal sense) in the subjective experience? Heidegger's question, conversely, is significantly different. He approaches the question on another level by asking, what is the condition of possibility of the experience of space itself? And his solution is that space must presuppose a world, hence he resolves the paradox by assigning it a new ontological meaning:

> Space is not to be found in the subject, nor does the subject observe the world "as if" that world were in a space; but the "subject" *(Dasein),* if well understood ontologically, is spatial. And because *Dasein* is spatial in the way we have described, space shows itself as *a priori.*[13]

So to talk about space is actually to discuss spatiality, which is a comportment toward the world. Intentionality becomes situational; it is not directed from the subject to the object but arises from *Dasein*'s being "in." When it comes to a digital object, as we discussed earlier, we are not able to refer to space, because this space is a mere perception—for example, a 3D object does not occupy the physical space despite being determined by the understanding of physical space as having *x, y, z* coordinates assigned to the object (the value of the *z* axis can be much deeper than the thickness of the screen). For example, the method we use of sliding our finger across the screen of an iPhone to see the next picture produces the illusion that that there is a space beyond both sides of a picture. So it becomes impossible to grasp the spatiality of a digital object by attempting to record its dimensions or trying to reduce it to something on a screen that can be measured indirectly. What is more important here is to look beyond the spatial appearance of the digital object to spatiality as reference. As Heidegger put it,

> when space is discovered non-circumspectively by just looking at it, the environmental regions get neutralized to pure dimensions. . . . The "world," as a totality of equipment ready-to-hand, becomes spatialized *[verräumlicht]* to a context of extended things which are just present-at-hand and nothing more.[14]

That is to say, to understand a digital object, we should approach "cyberspace" as a totality of reference (i.e., its being-in-the-world). What is the being-with of a digital object? Is it the screen, the keyboard, the mouse, other entities on the screen, the operating system, or the hardware . . . ? Such answers remain very general, because in this totality of relations, we can include almost everything in the environment as objects. If we were to stop our inquiry here, we could say no more than saying "nothing" at this point. This is exactly the problem Heidegger encountered.

Heidegger's Interpretation of Relations?

How could our analysis go further than this general idea of totality as being-in-the-world? Unfortunately, we cannot find any direct hints in Heidegger, because he actually denounced the analysis of relations in *Being and Time.* His denunciation allows him to propose a radical understanding of temporality as care toward the ontological understanding of things. On the other hand, however, such an abstraction also blinded him from seeing the *dynamics* of ontological difference. To demonstrate this clearly, we must first go back to what Heidegger calls a relation *(Beziehung),* leading him to reject any further analysis of the concept of relations:

> Referring is, if we take it as formally as possible, a relating. But relation doesn't function as a genus for "kinds" or "species" of references which may somehow become differentiated as sign, symbol, expression, or signification. A relation is something quite formal which maybe read off directly by way of "formalization" from any kind of context, whatever its subject-matter or its way of Being.[15]

Heidegger rejects relation as being something too formal and general to provide a concrete meaning for reference. For Heidegger, relation is a superset, within which we have a subset called references, within which we find indications *(Zeigung)* as a further subset of references. We should therefore proceed from the concept of relation to its subsets—the referencing of equipment and the indication of signs:

> Every reference is a relation, but not every relation is a reference. Every "indication" is a reference, but not every referring is an indicating. This implies at the same time that every "indication" is a relation, but not every relation is an indicating. The formally general character of relation is thus brought to light. If we are to investigate such phenomena as references, signs, or even significations, nothing is to be gained by characterizing them as relations. *Indeed we shall eventually have to show that "relations" themselves, because of their formally general character, have their ontological source in a reference.*[16]

How could relation be explained by its reference (i.e., a superset by its subset)? This is nevertheless a riddle, an interesting logical question that constitutes the core of Heidegger's hermeneutic thinking. We can engage with and understand Heidegger's proposal by thinking of being-in-the-world as the foundation of all discourse, therefore any form of relation always presupposes the world. But because we cannot then attain any clarity of being-in-the-world—unless it remains a mystery—then the "in-itself" would be unknown. Science addresses the formalization of relations, while for Heidegger an existential analysis must find its point of departure somewhere else, and this is the temporal analysis. The totality of reference is also a temporal structure of being there. In *History of the Concept of Time,* we read,

> Circumspection oriented to the presence of what is of concern provides each setting-to-work procuring, and performing with the way to work it out, the means to carry it out, the right occasion, and the appropriate time. This sight of circumspection is the skilled possibility of concerned discovery.[17]

Being "skilled" is a consequence of time, according to Heidegger. He responded to traditional ontologies by arguing that beings *(Seiendes)* should be understood through time. I would argue here that his analysis is partially correct because it only belongs to one order of magnitude specific to the phenomenological tradition. The problem we identified, however, is the question of beings, or the given. We have emphasized that treating a technical object as though it were an apple on a table is not only a mistake but also a risk. Heidegger is therefore plausible when examining the mode of existence of technical objects, but like Husserl, he did not concern himself with how *Dasein* becomes absorbed in the world. This givenness, in the Heideggerian sense, also disguises what he calls the "founding steps":

> I can at any time perceive natural things in their bodily presence directly, that is, without running through the founding steps beforehand, because it belongs to the sense of being-in-the-world to be in these founding steps constantly and primarily. I have no need to go through them because *Dasein* which founds perceiving, is nothing but the way of being of these very founding steps, as concerned absorption in the world.[18]

Husserl and the Problem of Givenness

Heidegger's reluctance to approach the founding steps comes out of what we may consider a general attitude prescribed by phenomenology. This attitude is already present in the literal meaning of phenomenology, which tends to be reluctant to speculate beyond the phenomenon. We could also understand this as a difference of orders of magnitude. Indeed, we encounter here a similar problem regarding Husserl's argument concerning the givenness of data. This hypothesis also resonates with Michel Henry's critique of Husserl's mistreatment of givenness and Heidegger's interpretation of phenomenology. In his book *Material Phenomenology,* Henry argues that Husserl did not do justice to what he calls the "hyletic data" (meaning sense data), and the appearance of objects, which he denoted as "givenness." Givenness has two senses: (1) the mysterious sensation *(Empfindung)*—a "type of givenness and given in which the mode of givenness is itself the given"—and (2) the constitution of the noetic acts. Henry argues that "transcendental phenomenology, as intentional, is limited to the description of this second givenness, to the analysis of its essential modes and the various types of *noesis* and *noema* corresponding to it."[19]

This means that Husserl leaves the how and why of givenness unexamined, as he perceived the first givenness simply as given; that is, sense data are given automatically upon every encounter. We may recall here our discussion at the beginning of chapter 1 of the Latin root of *data,* as the plural form of *datum,* meaning "the given." Husserl uses two words, *datum* and *Gegebenheit*; however, there is little distinction made, and in the interpretation of Husserl, notably in Suzanne Bachelard's *A Study of Husserl's Formal and Transcendental Logic,* she translated them into the same French word, *donnée,* used for both "data" and "the given."[20] Now besides the hyletic data as given, we also have another (or the third) givenness that comes out of a technical ensemble (later we will see that it is a technical system) including censors, interfaces, algorithms, databases, networks, and so on. The problem arising here is that the transcendence of an object is pulled down to the immanence of consciousness, and consequently, the interaction between objects and subjects is reduced to two simple modes: passive and active. The passive mode of seeing is also what Husserl named the "pre-predicative moment"—for example, when first entering the room, the room is given to me as a passive seeing before I adjust my intention to focus on a specific object. This room as a background for further investigation is the primary givenness. In his 1907 lectures (later edited as a book, *The Idea of Phenomenology*), Husserl understood the active mode of seeing as the process of explication, which bears with it the complexity of noetic acts. These two modes of seeing also distinguish Husserl from Hume and genetic phenomenology from the association of ideas. For Hume, consciousness is a correspondence of factual reality, while Husserl suspends "factual reality" and defines it as an "immanent term whose being-sense depends on consciousness."[21] For Husserl, a sign is based on the principle of a Humean association of ideas, which is nevertheless for Husserl too passive—a "senseless bundle of/or collection of data."[22] The superiority of active seeing over the passive mode exposes the weakness of the Husserlian phenomenology. As Henry writes,

> intentional phenomenology is transcendental phenomenology, but the transcendental reduced to the intentional *noesis* is not truly a transcendental, an *a priori* condition of all possible experience, if it always requires what is wholly other than itself: the sensation, the impression. The latter must first be given in order for any experience whatsoever to take place.[23]

So the problem we are coming up against is how we can make sense of this "other than itself" and the "founding steps." Husserl cannot accept this "other than itself" as the constitution of subjectivity, because it renders the *cogito* impure. Henry's prompting to tackle the question of first givenness and first immanence can be further understood in two broader senses. First, sense data weren't properly addressed in Husserl's phenomenology but were rather subsumed to the active explication of the *cogito.* Second, givenness—the occurrence of the object as a phenomenon—is not questioned, except in terms of the transcendental reduction. The source of this ignorance on the part of phenomenology in general comes from the order of magnitude. And to resolve this question, we need to look into another order of magnitude and attempt to resolve this difference by reintroducing the concept of relation. It is significant that modern technology, through the appropriation and modification of the "founding steps" and "other than itself," reconstitutes our experiences, including time. We can then follow two paths in approaching the subject matter: (1) the empirical and logical tradition—especially in David Hume's philosophy of relation and Bertrand Russell's relational calculus, and (2) concerning Husserl and

Heidegger's interpretation of temporality as the primordial relation. These two lines of thinking can also be considered examples of "ontological difference." Ultimately, we will be able to say that this ontological difference corresponds to a difference of two orders of magnitude.

Aristotle's Dilemma of the Relative and Medieval Interpretations

The theory of relations is always undermined because of its generality, as proclaimed by Heidegger. Yet it has always been indecisively thought, since the beginning of Aristotelian philosophy. In chapter 7 of *Categories,* Aristotle first identifies relation as one of the following ten categories: substance, quantity, quality, relation, place, time, posture, state, action, and undergoing (in the sense of being affected). The category we translate as "relation" was named by Aristotle *ta pros ti* (τὰ πρός τι), which literally means "things toward something."[24] Aristotle became rather indecisive about this particular category, because a comprehensive definition did not seem possible. In later chapters, Aristotle continued to add another five *relational categories,* namely, *opposition, priority, simultaneity, motion,* and *having.* What is it exactly that makes relation so difficult to define? He gives the following definition:

> those things are called relative which, being either said to be of something else or related to something else, are explained by reference to the other thing.[25]

He went on to explain different types of relations in terms of reciprocity and spontaneity. Hence, if we follow the logic of Aristotle, we can derive the following three conclusions: (1) relations are items that relate to substance, (2) the items that relate to substances are accidents, and (3) no substance is a relation.[26] In *Metaphysics* V 15, Aristotle discussed again the question of relation, where he classifies three types of relations, including (1) identical relations (e.g., double to half, treble to a third); (2) causal relations (e.g., between action and passion, to heat and being heated); and (3) psychological relations (e.g., measure to measured being).[27] In both occasions, the relation between substance and relatives remains obscure. A question stands out: is substance relative at all? Aristotle has doubted in *Categories,* because, for example, beings such as man and horse can be defined without referent to others, but for some secondary substance, such as head and hand, they may not exist on their own. However, because we know that a substance is "neither said of a subject nor in a subject,"[28] it will be problematic if there are cases in which they are relative. For the second question, if we can consider that A is whiter than B, then is "whiter" a predicate belonging to a subject that is neither A nor B, or it is also a real being? The second question was notably raised by Henry of Ghent.[29] By the end of his section on the "relative" in *Categories,* Aristotle left the interpretation open-ended:

> Indeed, if our definition of that which is relative was complete, it is very difficult, if not impossible, to prove that no substance is relative. If however, our definition was not complete, if those things are only properly called relative in the case of which relation to an external object is a necessary condition of existence, perhaps some explanation of the dilemma may be found.[30]

This dilemma remained a puzzle for centuries and generations to come. Boethius (circa A.D. 480–524 or 525), a translator of Aristotle's *Categories* into Latin, thus proposed it as task for the philosophy community:

> Aristotle would never have said this if he were not prompting us to further reflection and to even greater exercise of subtlety. Because of his exhortation, we shall not hesitate in the least to raise [further] questions and offer [our own] solutions to them in other places.[31]

The question concerning the nature of relation concerned almost every philosophers: Avicenna, Thomas Aquinas, Albert the Great, Henry of Ghent, Duns Scotus, and so on,[32] in the process of the establishment of an onto-theology that combines Aristotelian metaphysics with the science of divine. The nature of relation is particularly interesting for the theologians, because it is closely related to the trinitarian question, to explain "how in god the persons are identical with the divine essence, yet different among themselves."[33] Even though the answers are largely theological, their philosophical contributions shouldn't be overlooked. Here two inquiries concern us that I summarize as follows: (1) Is substance relative at all? (2) Is relation a real being? The first question is normally refused. It can be said to be relative to something else, but it is self-substantial, because if substance is relative, then it means the divine essence that creates it can also be relative. This question is hence not valid because it disapproves God. This question wasn't discussed until the arrival of the skepticism of Hume, which we will elaborate later. The other question is whether relation is a thing that exists independently, namely, whether it has its own substantial being. These two questions are tantamount to two kinds of interpretation: (1) relation according to speech *(relationes secundum dici)* and (2) relation according to nature and being *(relationes secundum esse).*

For the first interpretation, relation is a pure "toward something else" that has its foundation on accidents and is determined by the intellect. For example, if Simmias is taller than Socrates, the relation "taller-than" is nothing but the manifestation of other predicates, such as tallness. We can probably follow Brower and call this interpretation a reductionist reading. Avicenna defines relation as "that the quiddity of which is said with respect to another thing."[34] Avicenna further defined three types of relations, according to the way a relation is perceived: (1) need two extreme terms, (2) need only one term, or (3) none of them (e.g., left–right). We can understand that Avicenna didn't want to inquire into the substantial being of relation, because for him existence is an accident of essence, and hence being as such is already determined by the essence. It is worth noting that Avicenna doesn't understand accident according to the Aristotelian categories but rather as a list of "predicables" *(prédicables),* for example, genre, species, difference, proper, and accident.[35]

Following Avicenna, Henry of Ghent rejected that "relatedness toward" can be called *res* having its own quiddity. He has hence reformulated the question: it is not of the thing toward something but of the being toward something, not as *res* but as a mode of being. Other than a substantial and accidental being, there is a relational being.[36] Decorte interprets that for Henry of Ghent, relation is a mode of being: "it will be the nature or the essence itself that will determine whether or not this relational being will be present. . . . In other words, this relational being will depend on the essence being ordered, by its own nature, towards something else."[37] This reading of Henry of Ghent is already a bit different from Avicenna's, because it affirms the existence of a relational being that is extramental.

Henry's interpretation of relation comes out of his critique of Giles de Rome, who represents what Brower calls nonreductionist or realist reading. For the realist, a concept must have its extramental existence. Hence, for the realist, they ask besides of its *esse accidentis* and *ratio generis.* Is there a *res* for relation? Theologians and philosophers such as Giles de Rome, Albert the Great, and John Duns Scotus wanted to understand relations as a sui generis monadic type,[38] existing on its own terms, and even as a thing. For example, if Simmias did not exist and Socrates were the only human in the world, relations such as "taller-than" and "shorter-than" would still exist. For the reductionists like Ockham, relations naturally become products of the mind, which then manifest themselves in speech. What the reductionists and the nonreductionists have in common is that they all regard substance as the ultimate reality, because it is used to explain the relation with the divine essence. But if we then speculate further, the second relation here *(relationes secundum esse),* according to Heidegger, prompts us to ask, "what if *esse* is understood here as Being *(Sein)* instead of being?" and "what if the *dici* and *esse* belong together?"[39] We cannot provide an immediate answer to these questions but will continue to address them throughout the remainder of this book, because they may only be clarified through the several paths of inquiry we have yet to follow.

This same question of relation was further developed by the British Empiricists. For example, as identified by Alexius Meinong, John Locke's theory of knowledge is actually a theory of relations.[40] However, for Locke, relation was still simply an idea that "the mind gets from . . . comparison."[41] I believe that it is rather in the thought of David Hume that relations gain their proper philosophical position. The theory of relations that we want to retrieve in this book should also serve as a critique of the *substance fetishism* of Western metaphysics.[42] Heidegger did not make his critique explicit, but we will see that Heidegger later gave up his inquiry into substance, disclosing it instead as a question of temporality. Modern technology, in my view, still insists on the question of substance. For example, the term *substance* is still often dogmatically used within formal ontology in information processing, while its actual meaning has already silently disappeared. I am not going to reuse the interpretation of the medieval philosophers (the *relationes secundum dici* and *relationes secundum esse* approaches), because they all assume the existence of substance and treat relations as predicates of it. I would rather make a distinction between discursive relations and existential relations. The discursive relation is similar to what Heidegger calls "formalization" or what Simondon calls "individualization," and the existential relation is similar to Heidegger's interpretation of temporality and what Simondon terms "individuation." It will be our task in what follows to demonstrate how these two concepts correspond to our analysis of the existence of digital objects.

Hume's Critique of the Aristotelian Substance–Accident Pairing

The insufficiency of the substance–accident pair has limited the understanding of things over centuries. Rodolphe Gasché, in his book *Of Minimal Things,* has suggested that "to a large extent, the emergence of a logic of relations in the last century results from the insight that the substance/accident ontology significantly limits the analysis of relation."[43] Gasché was referring to Bertrand Russell's logical atomism, yet we may observe that this discovery itself owes much to the legacy of British Empiricism, especially David Hume's atomism.[44] In the spirit of skepticism, Hume's first move was to destroy the concept of subject–predicate. He classifies our concepts of things into two categories: one is "impression" and the other is "idea." Impression, for Hume, is the immediate evidence of the existence of things, and it is also the source of all ideas. He distinguishes *two kinds of impressions*: "impressions of perception" (which still maintain the vividness of what is perceived within the mind) and "impressions of reflection" (which are affects like sadness or being hungry). An "idea" can roughly be considered to be a faint impression. So our knowledge should be grounded within these two forms of impressions. Hume began his argument by saying that because no one will "assert, that substance is either a colour, or sound, or a taste," the "idea of substance must therefore be derived from an impression of reflection, into our passions and emotions." Yet against this possibility, he then argued that "none of [these passions and emotions] can possibly represent a substance," concluding that "we have therefore no idea of substance, distinct from that of a collection of particular qualities, nor have we any other meaning when we talk or reason concerning it."[45]

Therefore, what is an object if it is not to be conceived in terms of substance and predicates? Hume argued that it should be understood in terms of relations. Hume's theory of relations is one of the least explored aspects of his philosophy, though his idea of association is well recognized as an important contribution to philosophy. Hume's philosophy of association is known as the psychology of association, according to which relations are the effects of associations. Our immediate reaction may be to ask, isn't relation simply the principle of association? But in fact they need to be carefully distinguished. If relation is the effect of association, then it is entirely dependent on association (i.e., a posteriori), whereas if it were the principle of association itself, it would be the a priori condition. For Hume, association cannot be an a priori synthesis, which is exactly what

Kant had found it necessary to argue for.[46] Hume's understanding of relation had been seriously underappreciated until midway through the last century, when Gilles Deleuze addressed it in his first book, *Empiricism and Subjectivity*,[47] in which he claimed to have found in Hume the novelty of external relations. It is believed that from both Hume and medieval philosophy, Deleuze developed his idea that "being" is univocal and can thus be expressed in only one way, which is that of relations.[48] Again, this notion of relation is ontological as opposed to being merely ontic or psychological.[49] Hume rejected Aristotle's categories, and most important, in my view, he first rejected the idea of substance and, second, radicalized relations as being the foundation of propositions. After rejecting substance, Hume went on to argue that "the idea of a substance as well as that of a mode, is nothing but a collection of simple ideas, that are united by the imagination, and have a particular name assigned to them, by which we are able to recall, either to ourselves or others, that collection."[50] We may say now that substance is simply an idea of the collection of all properties. In other words, substance is a fiction that presupposes relations. Therefore, when we look at an object, the properties can be isolated as abstractions or as simple ideas. Hume makes the following statement:

> We consider the figure and color together, since they are in effect the same and undistinguishable; but still view them in different aspects, according to the resemblances, of which they are susceptible.[51]

This is a somewhat radical approach to both substances and predicates, as predicates belong to substance. So once Hume rejects substance, he must also reject predicates as the predicates of substance. In other words, he must look for another definition of *predicate*. This new definition of predicate can be found in the idea of relations. *This does not mean that predicates are relations but rather that predicates presuppose relations, for example, relation is its mode of being*. Hume did not, however, reject all presuppositions about predication. For example, if an apple is red, redness is the quality of the apple, and this can hardly be contradicted. But as the preceding quotation implies, the unification of an apple in the understanding requires two steps. First, the mind cannot demonstrate the necessary connection between the roundness of the apple and its redness; they are simple ideas given by impressions. This indicates that they did not originate from the substance of the apple but as something dispersed through space and time and reaching us passively via the gaze. Second, redness is red because it is neither green nor blue, as the roundness is round because it is neither square nor oval. This means that the predicates already presuppose comparison, that is, relations. So the idea of an apple is based on two levels of relations: (1) relations of resemblance, for example, whereby the redness and the roundness are different from greenness and squareness, and (2) relations of contiguity—because of their temporal and spatial copresence, roundness and redness are unified within the single idea of a red apple. Whenever a new property of the object is discovered, a relation will subsequently need to be disclosed. The new property will become unified with the "idea of the substance." In the example of gold, Hume demonstrates that the idea of gold "may at first be a yellow colour, weight, malleableness, fusibility; but upon the discovery of its dissolubility in aqua regia, we join that to the other qualities, and suppose it to belong to the substance as much as if its idea had from the beginning made a part of the compound one."[52]

Husserl's "Radical Interpretation" of Hume

We have now moved halfway beyond substantial fetishism. We still need to address the question of where the associations end and the object begins. Husserl's critique of Hume can help to clarify this point, whereby we can also identify Husserl's influence on Heidegger when considering the latter's rejection of a theory of relations (i.e., Husserl's departure from Hume's associationism to a temporal understanding of cognitive process, of genesis). Husserl made a similar interpretation of Hume's relations in the *Logical Investigations,* which Richard Murphy has called a "radical interpretation." However, according to Murphy, Husserl totally rejected Hume's idea, because Hume "has involved himself in an infinite regress."[53] Accordingly, if the color, shape and other properties were to be denied "real immanence in the phenomenal object as a whole, recourse to resemblance and attention is in vain."[54] In other words, to arrive at an idea of the object, one would have to go on drawing comparisons ad infinitum. Murphy further suggested that Husserl's radical interpretation is not valid, because it misunderstands what Hume had originally meant.[55] Murphy argues that Hume identified abstract moments with "modes," as "modes are simple ideas which represent qualities found in different objects or, if found in the same object, do not give rise to complex ideas." He therefore sees Husserl's radical interpretation of Hume as a misreading. Let us have a look at what Hume wrote about modes, following the example of the gold as described earlier:

> That this cannot take place in modes, is evident from considering their nature. The simple ideas of which modes are formed, either represent qualities, which are not united by contiguity and causation, but are dispersed in different subjects; or if they be all united together, the uniting principle is not regarded as the foundation of the complex idea.[56]

What Hume actually meant was that modes cannot be unified through contiguity and causation. When we talk about the quality of the object, these simple ideas are "at least supposed to be closely and inseparably connected by the relations of contiguity and causation."[57] Here Hume actually assigns different roles to different relations; for example, if resemblance is the relation that distinguishes the properties perceived of a subject, then it must also employ the relations of contiguity and causality to allow a unification of the object. Husserl's critique of the infinite comparison sounds very logical at first glance; however, Husserl himself did not take into account the presupposition of Hume's empiricism. This can in fact be resolved (1) by the limitations on the knowledge the subject is able to acquire, which is indeed a computational question, and (2) by the provision that, when the sample pool grows too large, the numbers of comparisons can be reduced via the habits the subject develops in her daily life, because the relation of resemblance is transformed into the relation of causality. The second point corresponds to Hume's very famous skepticism regarding the necessity of causal relations. This is a topic to which we shall return at a later stage of this chapter.

In fact, whether Husserl's interpretation is right or wrong is not crucial here. We should certainly take Husserl's skepticism further than current technical understandings. The difference between Husserl's active model and Hume's passive model lies less in the association of ideas than in the temporal process of the formation of ideas. The passive association of ideas cannot constitute the temporal experience of the ego, that is to say, its intentionality, without which there is no time. Hence Husserl's theory of relations is not atomism in the Humean sense but rather a theory of temporality that he had already previously demonstrated in the *Phenomenology* *of Internal Time Consciousness.*[58] We might ask whether one can find in atomism the possibility of rediscovering a theory of relations equivalent to that which was proposed by Aristotle at the very beginning. However, we would subsequently encounter the difference between the orders of granularities, which we have discussed. And even if we have rediscovered an earlier theory of relations, the salient question is still, how would it suffice as the foundational understanding of digital objects? What would be the significance of understanding digital objects from this perspective?

Hume's Philosophical Relations

Hume mentioned association and relations frequently throughout *A Treatise of Human Nature* and *An Enquiry Concerning Human Understanding,*[59] yet there is an evident lack of coherence across his discussion. This has given rise to much confusion. Hume addressed the question of relation in two different contexts. In the first part of *A Treatise of Human Nature,* he introduces the three key ideas of associationism, namely, resemblance, contiguity, and causality. These three relations naturally link ideas together and "upon our conception of any idea, the animal spirits run into all the contiguous traces and rouze up the other ideas, that are related to it."[60] These three relations, known as associationism, are often misleadingly taken as constituting Hume's entire theory of relations. I will investigate here a further understanding of Hume's relations and their significance for computation. We will need to consider here how we can understand relations in a broader context: from Hume and beyond Hume. Later in the same section, Hume points out the inadequacy of these three relations, which he calls "natural relations," and introduces a more comprehensive understanding that he calls "philosophical relations." Distinguishing the two, he writes that relation can be used

> either for that quality, by which two ideas are connected together in the imagination, and the one naturally introduces the other, after the manner above explained: or for that particular circumstance, in which, even upon the arbitrary union of two ideas in the fancy, we may think proper to compare them.[61]

So we have two kinds of relations here. The first relies on a direction pointing from one idea to another. The second, the philosophical relation, extends the sense of relation "to mean any particular subject of comparison, without a connecting principle." So in this sense, distance can be considered to "be a true relation."[62] On the basis of this outlined redefinition of relation, Hume derived seven categories of relations: *resemblance, identity, space and time, quantity, quality, contrariety,* and *causality*:

Resemblance: without which no philosophical relation can exist, because no objects will admit of comparison, despite having some degree of resemblance
Identity: of all relations the most universal is that of identity, as being common to every being whose existence has duration
Space and time: the source of an infinite number of comparisons, such as distance, contiguity, above, below, before, after
Quantity/number: all of those objects that admit of quantity, or number, may be compared in that particular
Quality/degree of quality: when any two subjects possess the same quality in common, the degree in which they possess it forms a fifth species of relation
Contrariety: no two ideas are in themselves contrary, except those of existence and nonexistence, which are plainly resembling, as implying both of them an idea of the object
Causality: all other objects, such as fire and water, heat and cold, are only found to be contrary from experience, and from the contrariety of their causes and effects

Hume additionally distinguished two kinds of relations among these seven categories: "'such as may be chang'd without any change in the ideas' (identity, temporal and spatial relations, causality), and those that 'depend entirely on the ideas which we compare together' (resemblance, contrariety, degrees of quality, and propositions of quantity and number)."[63] The former is known as the internal relation and the latter as the external relation. An internal relation is "one grounded in the entities it relates and in nothing else." An external relation is "one grounded in some entity wholly outside the entities related." An example of the internal relation could be that middle E is higher in pitch than middle C. An example of an external relation could be that the glass of water is above the table.[64] The charm of Hume's relation theory is that it reintroduces the idea of an external relation that cannot be absorbed into the substance–predicates paradigm. This external relation has to be reintegrated with Hume's definition of the idea of substance, as we discussed earlier in considering Husserl's interpretation. There are two different ideas about externals we should consider. First, by definition, the predicates are already externalized from the subject in the sense that they are dispersed throughout time and space, waiting for a unification via the imagination. Second, our perception of the world is always the *play* of relations. This implies that the object does not exist on its own. So for Hume, there is actually no such thing as the internal relation, which still remains at the core of Aristotelian science. Deleuze thinks that this division of relation, according to internality and externality, is exactly what Kant believed in, as he grounded his critique solely on Hume. Deleuze defends Hume, making explicit his understanding of relation—that all relations are external. He quotes from Hume's *Treatise* in supporting his argument:

> Let us consider, that since equality is a relation, it is not, strictly speaking, a property in the figures themselves, but arises merely from the comparison, which the mind makes betwixt them.[65]

If comparison were therefore the foundation, then every relation would be external. Following from Hume, we can actually develop an analysis of relations via his seven categories. One would be right to imagine that Heidegger may not have easily agreed with this, as he would naturally object to its formalization. Yet for Hume, his understanding of relation had its radicality in rejecting the traditional dualism within metaphysics in terms of substance–accident and matter–form. We could even go a step further and say that a thing is not a product of an a priori concept but is based on the contingency of the association of ideas. Kant could not tolerate this, so he developed a transcendental critique to define the necessity. He commented, "David Hume recognized that in order for us to be able to do this, the origin of these concepts must be a priori. But he was quite unable to explain how it is possible that concepts not in themselves combined in the understanding should nonetheless have to be thought by it as necessarily combined in the object. Nor did it occur to him that perhaps the understanding itself might, through these concepts, be the author of the experience wherein we encounter the understanding's objects."[66] We may infer from this that Kant took two steps away from the Aristotelian approach to categories. In the twelve categories proposed by Kant, he gave a higher priority to relations. Relation together with quantity, and quality together with modality, comprise the four classes of categories. Within each class, we find three categories. I would say that the first advancement of Kant was his clear proposition that the substance–accident relation only constitutes one of the three types of relations instead of its totality. Kant was aware of the arbitrariness of the number of categories, hence he proposed to differentiate the root concepts from the derivative concepts. Kant uses the word *prédicables* in contrast to the predicaments used to describe these "pure but derivative concepts," hoping in the end to be able to "depict completely the genealogical tree of pure understanding."[67] The predicables are something rendered possible by the progressive development of derivative categories, which in this sense implies a richer experience of objects. But did Kant really move beyond Hume? This is perhaps the defining crux between philosophical thought and scientific thought, whereby the resolution and progress of philosophical thought are not necessarily guaranteed by later discoveries. We could well argue here that in Kant's *Critique of Pure Reason,* there is a step backward regarding the overall philosophy of relations; only in the *Critique of Judgment,* Kant's concept of the organic form developed in the exploration of the teleological judgment cast new light on the concept of relations and hence went beyond the dominant mechanical view of his time to concepts such as community *(Gemeinschaft)* and reciprocity *(Wechselwirkung).*[68] In section 64 of the *Critique of Judgment,* Kant defines the organic being as follows: "a thing exists as a natural end if it is (though in a double sense) both cause and effect of itself."[69] Kant follows by giving an example of the tree and points out three elements that define it as such a being. First, the tree reproduces itself according to its genus, meaning that it reproduce another tree; second, the tree produces itself as individual—it absorbs energy from the environment and turns it into nutrients that sustain its life; third, different parts of the tree establish reciprocal relations and thus constitute the whole—as Kant writes, the "preservation of one part is reciprocally dependent on the preservation of the other parts."[70] The concept of the organic being consists in the reciprocal relations and the identity as a tree that defines its natural purpose. I will, however, reserve this discussion of Kant's organic form for elsewhere and only pursue the mathematical interpretation of relation here.

Before we go further into our own agenda of relations within this book, let us go back to *relationes secundum dici* and *relationes secundum esse* to for-

1. Quantity
Unity
Plurality
Totality

2. Quality
Reality
Negation
Limitaton

3. Relation
Substance
Causality
Community

4. Modality
Possibility
Actuality
Necessity

Figure 16. Kant's grouping of twelve categories.

mulate a brief summary in preparation for our following inquiry. To distance ourselves from the Aristotelian line of inquiry, I propose two new terms: *discursive relations* and *existential relations.* Within this schema, Hume's relations are discursive relations, because the presupposition is that we can only sense phenomena, which can then be described and related to each other through relations. This discursive relation does not mean that a thing must be spoken of as relating to other things, but it *can* be regarded as relating to other things (we can also understand the word *prédicables* in this sense). This ability to express is the ultimate foundation of Hume's understanding of relations: because we cannot tell what the substance is, we shall need to surrender the idea of substance. These discursive relations are fundamentally technical. The networks they constitute are based on the supposition of description and associations, or, more precisely, on the analyticity of language, and the possibility of being materialized. Heidegger contributed to what we are now calling existential relations: the sedimentations of experience and nonexperience that constitute the "already-there" and the *Umgang* with the world. "Being in" is always within the various pasts of the world that can be discursively described, and yet this "being in" itself escapes description and quantification. By the same token, we will also come to recognize that language is not only a descriptive tool but is itself also a unity of temporal relations. The next stage of our analysis is to demonstrate how this understanding of mind and discursive relation is concretized within mathematics and modern computing. Here we cannot present a long history, but we can point to two decisive moments. The first is the development of relational calculus in mathematics, and the second is the appropriation of relational calculus in the development of the relational database.

The Formalization of Relations in Leibniz and Russell

The turning away from analysis of classes toward relations in mathematics was a very significant move within the last century. These relations are carried in the logical propositions and thereby model the basic structure of the metadata we are dealing with. This turn is especially important in Bertrand Russell's *The Principles of Mathematics,*[71] in which he dedicated several chapters to relations. Russell's logical atomism, as the convergence of rationalism and empiricism, had its full expression in Wittgenstein's *Tractatus.*[72] Russell's theory of relation also directed a critique against treating relations as a specific class, as Aristotle did. It is known that Bertrand Russell, in his monograph *A Critical Exposition of the Philosophy of Leibniz,* criticized Leibniz as being a reductionist who proposed that "every proposition has a subject and a predicate"[73] and consequently ignored relations. The notion of relation in Leibniz's thought is rather complicated; some readers may first raise the objection that, for Leibniz's system, as found in his *Monadology,* there is no place for relations, because monads don't have windows. Meanwhile, some other authors in analytic philosophy, such as Massimo Mugnai, have argued for a theory of relations in Leibniz's logic, and in Continental philosophy, it has been argued, notably by Christiane Frémont, that Leibniz's system is fundamentally a system of communication and hence relational.[74] It is not the aim of this book to elaborate these arguments but rather to show that there is a notion of relation that has been fundamentally ignored in the works of Leibniz. It is true that Leibniz undermines relations. In a letter to Temmik, he wrote:

> In addition to the substances, which are final objects, there are the modifications of the substances, which are subject to creation and destruction in their own right. And finally, there are the relations, which are not created in their own right but result from the creation of other things; their reality doesn't depend on our intelligence—they inhere without anyone being required to think

> them. Their reality comes from the divine intellect, without which nothing would be true. Thus there are two things which only the divine intellect can realise: all the eternal truths and, of the contingent ones, those which are relational.[75]

Relations are not accidents (which are modifications of the substance) but rather accidental. Relations are not real but rather virtual, because they do not manifest themselves through the subject–predicate reality but in a second process formalized by the intellect. This notion of relation becomes very clear when we understand that Leibniz's *ars characteristica* is an attempt to construct a system of signs in which each sign expresses the true categories of thinking,[76] for example, *notio primitiva et distincta.* This new system of signs distinguishes itself from alphabetic writing in two ways, as Rita Widmaier points out: (1) the *Zeichensystem* doesn't correspond to acoustic analysis but semantic analysis (it is largely visual) and (2) it doesn't follow an abstract convention but a projective convention (it is largely imaginary). In other words, he wants to create an iconic model *(ikonisches Model)* of thought instead of an analog model.[77] The coherence (relations) between signs and things follows a preestablished harmony and integrates Leibniz's theory of logic into his whole systematic thinking of theology and cosmology. But this preestablished harmony demands *traces*; as Leibniz wrote, "if the sensible traces were not required, the re-established harmony between the soul and the body . . . wouldn't have place."[78] What are these traces if not the materialization of relations between basic thoughts? Leibniz's project of the *Characteristica Universalis* is fundamentally a system of expression as well as communication. Conversely, Russell's critique is sound, because Leibniz himself didn't understand these traces in terms of relations, though it is clear that he wanted to construct such relations. This becomes even more evident if we consider Leibniz's 1666 doctoral dissertation "De Arte Combinatoria" and his later interest in drawing inspiration from Chinese characters to develop his signs. This project was further taken up by Gottlob Frege in his Begriffsschrift system, and there is a history of modern logic leading from Frege to the invention of the Turing machine (see chapter 5).

Russell criticized the ignorance of relational calculus as an unconscious philosophical error in mathematics. In criticizing the symbolic logic developed by Peirce and Schröder, he pointed out that

> their method suffers technically (whether philosophically or not I do not at present discuss) from the fact that they regard a relation essentially as a class of couples, thus requiring elaborate formulae of summation for dealing with single relations. This view is derived, I think, probably unconsciously, from a philosophical error: it has always been customary to suppose relational propositions less ultimate than class-propositions (or subject-predicate propositions, with which class-propositions are habitually confounded), and this has led to a desire to treat relations as a kind of classes."[79]

To provide an example, let us look at a subject–predicate class proposition such as "The apple is green," where there is an undeniable relation between the subject (apple) and the predicate (green). Moreover, we can develop this into the phrase "the apple has a green color." This "has" is still logically an "is," because the two are the same in this case. If we say "the apple tree has a green apple," we cannot turn this into "the apple tree is a green apple," because "has" places the two elements in a part–whole relation. The *is* and *has* relations have already been well explored by Husserl,[80] so we will not go into too much detail here. The key point for us is that there are some relations that escape internalization. In our example "the tree has a green apple," we can identify the whole–part relation, which is still nevertheless an internal relation. As we noted earlier in the introduction, if we consider another example, such as "Heidegger knows Bertrand Russell" or "I am taller than you," it becomes impossible to think of these statements in terms of subject–predicate and class proposition (Heidegger and Russell cannot be reduced to a class proposition—besides, both of us belong to the same class, "human being"); however, there still needs to be an independent mathematical treatment of this. Russell suggests that it could be expressed as *xRy,* in which *x* is understood as *referent, y* denotes *relatum,* and *R* denotes *relata.*[81] It is also relevant here to think of the relative product, which, according to Russell, is of great importance—"since it doesn't obey the law of tautology, it leads to powers of relations: the square of the relation of parent and child is the relation of grandparent and grandchild, and so on."[82] The relational turning point in mathematics prompted Russell to declare that "we can now develop the whole of mathematics without further assumptions or indefinables."[83]

Relational Calculus and the Relational Database

Relational calculus has been further developed in modern mathematics and computer science into the two following branches: (1) tuple relational calculus and (2) domain relational calculus. We have mentioned in the introduction that the mathematician and information scientist Edgar F. Codd has used the tuple relational calculus as the base of the relational database. Today we are aware that most information retrieval technologies (both online and offline) are more or less built on relational databases. The relational database did not become popular until the 1980s. The years 1968–80 can be characterized as the era of the nonrelational database, which was dominated by two other models, namely, the hierarchical data model and the network data model (developed by Charles Bachman). The problem with these earlier models is that they were difficult to maintain and lacked structural independence. The idea of the relational database is based on the introduction of two main qualities: "(1) data independence from hardware and storage implementation and (2) automatic navigation, or a high-level, non-procedural language for accessing data. Instead of processing one record at a time, a programmer could use the language to specify single operations that would be performed across the entire data set."[84] The attributes of a table specify the properties and relations of the data stored in it, but they are not the totality of relations, for they also produce relations through comparison, for example, difference or sameness. These relations, in comparison with the relation Heidegger talked about in *Being and Time,* are not merely symbolic but also numerical and calculable. Through the query languages, Amazon is able to find information regarding the "who, when, where" of buying Heidegger's *Being and Time.* It can also find relations between people who bought *Being and Time,* for example, in terms of age group or whether they are classmates.

The key element of relational databases is their use of relations that are created by the comparison of names, as names are primarily identified to denote certain relations. Machines situate themselves in between these two layers, becoming the interpreters of relations. For machines are able to generate and process a large amount of data and relations, where the capacity of the human mind to do so is limited. This simple fact regarding the limitations of human memory and capacity for calculation has been known for a long time. We will see clearly later that data are themselves relations and also sources of relations. The current technological condition

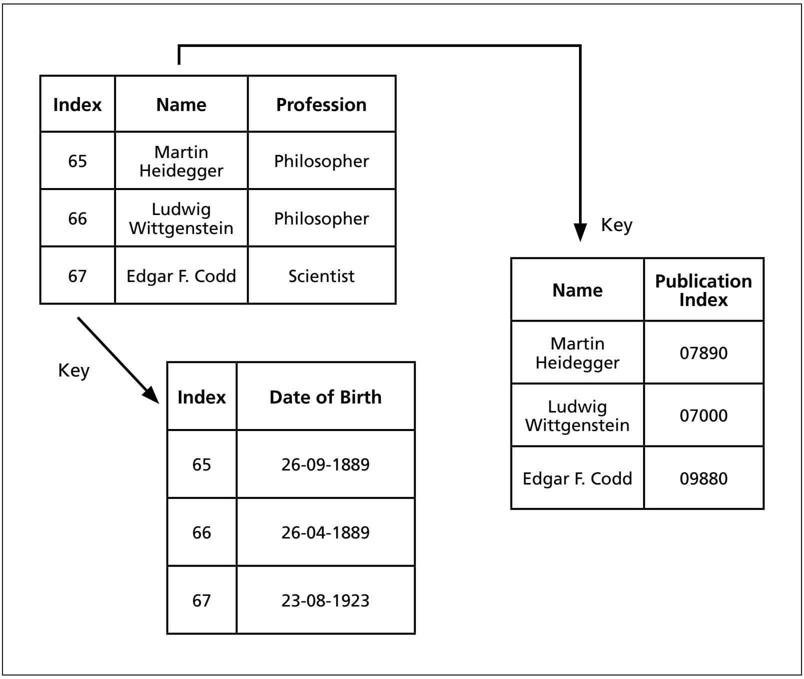

Figure 17. An illustration of a simple relational database. According to the keys, we can search across different tables for one query.

is characterized by the question of "big data." It appears that the production of data through online activities is set to increase, making any indicators obsolete within a relatively short period of time. To nominate these data as "useful" is to turn them into structured data. With XML, most data produced by mobile phone applications (e.g., web browser add-ons) follow a certain data scheme. As for the unstructured data, it is also possible to construct algorithms that can "normalize" them with an assigned structured meaning, for example, by identifying keywords. Let us now revisit the term *ontologies.* If we understand ontologies in an Aristotelian sense, we then already presuppose an internal relation intrinsic to the object. But if we see it as the possibility of producing external relations and the production of digital objects, an ontology suddenly reveals a new way of thinking. In a manner similar to Kant's categories, ontologies are also productive.

Relations, Uniform Resource Identifiers (URIs), and Information Retrieval

The semantic web is different from a relational database; however, they work as a pair and share the common principle of knowledge representation.[85] Illustrating this with a concrete case study will highlight the differences produced as a result of relational calculus. Without the ontologically driven information retrieval process—as on my personal web page—the ways of determining a relation between me and another person (e.g., Bertrand Russell) or an object are quite limited. For example, they can be determined through the recognizing of a link to the website of Bertrand Russell (URI) or by the recurrence of the name "Bertrand Russell" (e.g., if the name Bertrand Russell appears on my web page three times). Alternatively, the relation could be determined by extracting these data and computing with a certain coefficient, allowing a more refined relation between people–people or people–things to be established. The process turns out to be very complicated when more than two people have the same name.[86]

The second method of data extraction is via metadata, which is especially effective in the case of the semantic web. All metadata are well structured and prepared for machine compliance. Because of the employment of an ontology based on first-order logic, the computer is able to extract information through virtually infinitive linkages. Now let us consider a digital object and its metadata. These metadata operate exactly on the basis of the idea of relations—although following a recommendation of W3C, the resource definition framework (RDF) that specifies the core concepts of the semantic web. RDF is mainly based on the subject–predicate–object structure. Despite this making RDF sound like a conceptualization inherited from the Aristotelian tradition, it is actually based on the operation of relations. To give an example, finding the relation between, say, Martin Heidegger and Bertrand Russell is much easier in this framework because the ontology Friend of a Friend (FOAF) already indicates that I am associated with Bertrand Russell. In addition, the use of SPARQLE, a query language, makes information extraction easy (Figure 18).[87]

It is worth mentioning the recent discussion on NoSQL, which is a newly conceived data management technique that came out in 2009. NoSQL was named by the computer scientist Johan Oskarsson, who described it as "nonrelational."[88] This is rather misleading, because in fact NoSQL is not only not nonrelational but it has a more radical understanding of relation

```
<rdf:RDF xmlns:rdf='http://www.w3.org/1999/02/22-rdf-syntax-ns#'
  xmlns:rdfs='http://www.w3.org/2000/01/rdf-schema#'
  xmlns:foaf='http://xmlns.com/foaf/0.1/'>
<foaf:Person>
 <foaf:name>Martin Heidegger</foaf:name>
 <foaf:firstName>Martin</foaf:firstName>
 <foaf:surname>Heidegger</foaf:surname>
 <foaf:mbox_sha1sum>71b88e951cb5f07518d69e5bb49a45100fbc3ca5</
          foaf:mbox_sha1sum>
 <foaf:knows rdf:resource='#russell'>
</foaf:Person>
<foaf:Person rdf:ID='russell'>
 <foaf:name>Bertrand Russell</foaf:name>
 <foaf:mbox_sha1sum>241021fb0e6289f92815fc210f9e9137262c252e</
          foaf:mbox_sha1sum>
 <rdfs:seeAlso
 rdf:resource='http://rdfweb.org/people/brussell/foaf.rdf'/>
</foaf:Person>
</rdf:RDF>
```

Figure 18. An example expressing personal information and friendship in FOAF.

than a relational database does. The major difference between NoSQL and the relational database is that NoSQL doesn't define schemes in the same way. The relational database follows the ACID principles, namely, atomicity, consistency, isolation, and durability, to make sure that transactions are reliable. For some of the NoSQL data stores, the ACID principles are not important, especially when dealing with big data. NoSQL allows a dynamic scheme, and hence it can handle data that cannot be immediately categorized. For example, when the record is loosely organized in key-value form, one can easily add a new attribute without changing the whole scheme of the database.[89] To speak in terms of digital objects, this means that digital objects can be defined much more quickly and easily without having a Platonic idea of their type in advance. Hence one can say that the digital objects are not managed according to a predefined architecture, and indeed, any relevant information can be integrated as part of the digital object whose objectivity becomes less formal, but it would be wrong to claim that it has nothing to do with relations.

To some extent, it would be valid to say that content is not a key issue for a digital object; what really matter are relations. Throughout the web of digital objects, it is simultaneously a web of relations. In the context of social networking, these relations determine almost everything: friends, the space and time of an object, and so on. When Facebook suggests a remote friend to you, it does this precisely by accessing and operating upon relations. In the early period of the World Wide Web, a relation was only imaginable in terms of the hyperlink and reoccurrence; now relations are realized through data and dominate production on the Web. The era of the slogan "Content Is King" is over: relations have taken over. This does not mean that we do not *need* content but rather that content is rendered by forms into different relations. Thereby the primary function of content is to form resources for generating relations.[90] As we discussed in the first chapter on the individuation of digital objects from the perspective of metadata, this process of taking over is no accident but a historical consequence resulting from developments in computation.[91] In the preceding example of FOAF (Figure 18), the object consists of different relations that are unified by a "proper" name (not a general name) and identified with a unique URI. It is also worth mentioning in this context that Hume left a note at the end of his discussion of the seven relations:

> It might naturally be expected, that I should join DIFFERENCE to the other relations. But that I consider rather as a negation of relation, than as anything real or positive. Difference is of two kinds as opposed either to identity or resemblance. The first is called a difference of number; the other of KIND.[92]

Hume's apparent reservation in this short statement is actually unnecessary. In the OWL documentary of W3C, there is already a relation called "different from," which concerns the negation of identities.[93] This is not a coincidence but rather confirms that all logical propositions that construct the digital object already presuppose relations as the foundation of their existence. The association does not necessarily arise from psychology but rather from cognition, as we can identify in machines. In relational calculus, we are immediately confronted with endless connections, such as the emergence of networks, digitalized and materialized logical relations. Because a data network does not manifest from the interiority of a specific domain, representation itself already presupposes relations ontologically; a network can only be formed from a comparison of relations—it is the inference of relations that establishes a network for reference. For the Web and for linked data, there is not just one network but many networks that can be constructed by specifying different relations. From the preceding analysis, we can identify two fundamental understandings of relations.

First, there is Heidegger's understanding of signs as relations and the primacy of technical objects or equipmentality. Second, Hume's theory of relations was undermined, if not ignored, by Husserl's and Heidegger's phenomenology. Through their appropriation by web technology, Humean relations are becoming less noetic and more materialized. Our remaining task is to identify how these two kinds of relations can be unified to develop a better understanding of digital objects and the digital milieu.

Milieu and World: On Jakob von Uexküll and Heidegger

So far, we have seen two approaches to understanding objects in terms of appearance *(Erscheinung)* and composition, which simultaneously correspond to two different orders of magnitude. The phenomenal world takes "founding steps," to be "given" as the "already-there" of culture and memory without further inspection. The atomic world, however, seeks logical coherence without acknowledging what is outside its principles. These two approaches also provide us with two kinds of relations, one existential and one discursive. But these two types of relations cannot be totally separated, as an apple can exist neither solely as a collection of atoms nor solely as its appearance. At this point, it is probably fair to argue that digital objects dissolve in relations. It is technologies that, based on the principle of hylomorphism, shatter the concept of substance and hylomorphism itself and begin a new epoch of metaphysics. The concretization and materialization of relations give us a new mode of being-in-the-world. We may want to ask, to what extent can we value this philosophical trajectory of relations as we have outlined it? To address this, we shall go back to Heidegger's ready-to-hand.

It is important to note here that Heidegger actually considered relations to be the foundation of the understanding of "ready-to-hand," though he did not want to develop a concrete theory of relations as such. We have learned that for Heidegger, the "founding steps" can be put aside in our experience of the equipmental environment. For us, this means that the discursive relation and its temporal structure are already presupposed and have been embedded as something similar to habits or voluntary mechanisms. Ready-to-hand, as Heidegger says, belongs to the signification of an instrumental totality. This "belonging to" is not to be understood in terms of property or ownership but rather in terms of the "as-structure," the "something in order to" *(etwas um zu)* of the instrument.[94] As in Heidegger's example, when we use a hammer, we use it *as if there were time in the hammer itself*; there is something in the hammer we are familiar with. We simply grasp the hammer and hit the nail without scrutinizing the hammer itself. The ontological understanding of this temporality is care *(Sorge)*, which is made manifest from within the concern *(Besorgen)* of tools. Spatiality, according to Heidegger, is only existentially possible through temporality.[95] When Heidegger says "the animal is poor in the world" and "stone is worldless," he refers specifically to relations—a stone is worldless because its relations are only discursive relations, determining it as on the road, next to the tree, above the sand, and so on; animals are poor in the world but still nonetheless have a world. Giving the example of a lizard lying on a stone in the sunshine, Heidegger makes this explicit, stating that "the lizard has its *own relation (eigene Beziehung)* to the rock, to the sun, and to a host of other things."[96] The stones and the sunshine, for the lizard, are not present-at-hand but rather ready-to-hand. The ready-to-hand exhibits the two types of relations that we mentioned, while many readings of Heidegger easily favor the latter type (existential) under the title of "embodiment."[97] This understanding of the existential relation as embodiment is a simplification, if not a distortion, of Heidegger's ambition to tackle the meaning of "Being" in *Being and Time*. After all, Heidegger is not a scientist—even if he tended to analyze his subjects in a very technical and logical manner. As a consequence, his disciples were often too easily excited by the fact that Heidegger was scientific. Paul Bains, in his book *The Primacy of Semiosis,* identified the work of Jakob von Uexküll against Heidegger's ready-to-hand through the idea of *Umwelt.*

The *Umwelt* is what lies in between environment and context, in which the living animal subjectively interprets the significance of the *Umgebung* (the objective space) to produce its world.[98] For Uexküll, each animal has a different *Umwelt,* and each *Umwelt* subsequently has a different set of temporal and spatial frameworks.[99] As a zoologist, Uexküll gives us a detailed account of how an animal couples with the environment to produce an *Umwelt,* serving to aid in its means of survival. Uexküll's famous example is the tick and its interpretation of the environment. We shall first revisit the story of the tick:

> The blind and deaf tick needs to eat, so it climbs to the end of some twig or branch, where it may fall or be brushed off onto a passing mammal. The tick climbs towards light because its skin

> is photo-sensitive. It can detect an approaching mammal with its sense of smell (i.e., the mammal has a specific odour caused by its sweat glands). When the tick senses the odour (or sign) of the passing mammal, it drops (with luck) onto it and latches on. The tick is sensitive to temperature and seeks out a warm, hairless spot (e.g., an armpit), where it will pump itself full of blood, and become the size of a garden pea.[100]

Bains, through his study of the semiologist John Deely, compares the tick's biological adaptation to its environment with Heidegger's ready-to-hand in terms of embodiment. The tick does not live in the world of plant, wind, mammal, and so on; rather, it lives in the world as world. This world as world is an unthematized environment, which is to say, there is no representation of things but the things themselves. This at first glance coincides with our analysis of Heidegger's critique of the *Geganstand* as the problem posed by modern science and technology. Bains further quotes Heidegger's statement in *Fundamental Concepts of Metaphysics* (where Heidegger discussed and referred to von Uexküll's book *Umwelt und Innenwelt der Tiere*) that the animal's poverty in the world is "nonetheless a kind of wealth."[101] Bains tends to equate Heidegger's ready-to-hand with what he considers Heidegger's "prelogical apprehension of beings as a whole—[which] provides for the intelligibility of the objective world *(Unwelt)* presented in perception, apprehended in relation to itself."[102]

To identify this way of responding to the environment in terms of what Heidegger called "ready-to-hand" is problematic, and I believe that we must distinguish between the world that signals and the animal that selects the signals. They are different, to be sure, though they are not separable—because if the world does not give any signal, then the animal will not receive it. The question has primacy over the issue of addressing the intensity of the signals being given and being received. To understand this nuance, we should first briefly address the history of the word *milieu,* which George Canguilhem wonderfully outlined in *The Living and Its Milieu.*[103] In the course of the nineteenth century, there arose many debates and theories around the question of the milieu, for example, among thinkers like Auguste Comte, Jean-Baptiste de Lamarck, Charles Darwin, and Alexander von Humboldt. Within these debates, we may observe that the relation between the living and its milieu often became progressively more intimate, while at the same time the use of the explanatory term *milieu* became a scientific tool. This subsequently combined anthropology, biology, statistics, laboratory experiments, and philosophy to develop a way to understand evolution and human behavior. We can probably say that the very first understanding of milieu was as the atmosphere and circumstances that englobe the living being. For Lamarck, milieu specifically refers to fluid forms, such as light, water, and air. At the center of Lamarck's theory of the milieu is adaptation: when the milieu changes, we naturally adapt ourselves to hold on to it, not letting it go, as if it hadn't changed at all. It was Darwin who criticized these naturalists in his introduction to *The Origin of Species,* where he stated that "naturalists are always referring to external conditions like climate and food as the only possible cause of variations; they are only right in a very narrow sense."[104] Darwin offered two alternative understandings of milieu: (1) a social milieu of competition or struggle toward survival and (2) the geographical milieu of natural selection. Darwin extended the relation of the living and its milieu from an external environment toward social aspects, that is to say, toward a consideration of the relations between organisms themselves.

For Canguilhem, the word *milieu* can be also applied in understanding the theory of Uexküll—only we must pay careful attention to what is involved in the translation of the German *Umwelt* into the French word *milieu.* Canguilhem wrote, "Uexküll distinguishes between them with great care. *Umwelt* designates the behavioral milieu that is proper to a given organism; *Umgebung* is the simple geographical environment; and *Welt* is the scientific universe. For the living, the specific behavioral milieu *(Umwelt)* is a set of stimuli that have the value and significance of signals."[105] We can see here that the *Umwelt* is in fact no longer a milieu of the kind that we have seen before. It was under Canguilhem's own initiative that he decided to reevaluate his own theory of the milieu; however, Uexküll's notion of the *Umwelt* is something more along the lines of context. A context is a selection of significations of the subject. Context gives us another order of granularity within the analysis of the milieu. So if we identify Heidegger's *Besorgen* with the *Umwelt,* then we may easily fall into the trap of thinking that the *milieu/Umwelt* is the subjective selection of significations. What is a selection? And what is the space in between where one can select and alternatively be selected? We may perhaps say instead that the world becomes the center, and what is considered to be its selection is only one of the "functions" of the world.

Technics and Milieu: On Leroi-Gourhan and Stiegler

Technical objects (the hammer, the nail, the table, etc.) all constitute equipmental significances of the world. But what exactly is the world? It is by no means nature. Heidegger added a technical dimension on top of Uexküll's *Umwelt,* such that we can go so far as to say that Heidegger was indeed addressing the question of the technical milieu. The problem of modern technology is a result of the failure to construct the technical milieu, in which the moderns appropriate all things as calculative entities that can be ordered by "will" (because humans tend to take phenomena to be the totality of things). This is the danger Heidegger calls the *Gestell,* or *enframing,* as the essence of technology. Heidegger's idea of *Gelassenheit,* or *meditative thinking,* as the antithesis of calculative thinking is an urge toward an alternative experience of things. It does not by any means refer to an animal form of life as being authentic. We can make a brief comparison between Heidegger and André Leroi-Gourhan on the question of technical milieu here. Leroi-Gourhan attempted to develop the concept of the technical milieu into a *membrane* between the interior milieu and the exterior milieu.[106] The interior milieu is the part that is always alive and unstable; it is composed of an infinitude of elements, including used and stored products, internal secretions, hormones, vitamins, and so on. In contrast, one can perceive the exterior milieu as designating the part that is natural, inert, like wind, stones, and so on.[107] Technics is situated in between the interior and exterior milieux, instead constituting a technical milieu. The technical milieu is not something that we can isolate from the totality of our society for the purpose of analysis, and it cannot be separated from the interior and exterior milieux. Leroi-Gourhan wrote,

> The human group behaves in nature like a living organism, such as animals and plants, for whom the natural products are not immediately assimilable, but need the play of organs *(le jeu d'organes)* which prepares the elements; the human group assimilates its milieu through a set of objects (*un rideau d'objets* (tools or instruments)). . . . The study of this artificial casing *(enveloppe)* is technology.[108]

Understood in this way, the technical milieu is thus fundamental to Heidegger's understanding of the world. This would insinuate that a purely biological and physiological understanding of it is insufficient, as such a view would not be able to integrate technics into the *Umwelt.* This would mean that instruments and tools should also correspond to temporal relations. Bernard Stiegler, in his book *Technics and Time 1: The Fault of Epimetheus,* introduces a totally new approach and direction of thinking based on his interpretation of Heidegger. He proposes that it is this "anamnesis nature" of *technē* that constitutes the "already-there," as a history that belongs and is given to me, even though I have never experienced its establishment. The term "already there" *(schon da)* is borrowed from Heidegger, who uses it to indicate that at the time of *Dasein*'s thrownness, we immediately encounter the "already-there," or the world. The world is not nature but is necessarily historical. History is time, and its sedimentation in the form of technical objects gives us the world. This consideration leads to another interpretation of technics. Stiegler approached this from the myths of Prometheus. The fault of the titan Epimetheus originated from his forgetting to distribute skills to human beings, thus he only realized this problem after he had already gifted all the skills to other animals. So Epimetheus's brother Prometheus had to steal fire from the Olympic gods to give it to humans in compensation for their lack of intrinsic special skills. This would subsequently constitute the very beginning of *technē* in human life. The fault of Epimetheus was forgetting, which resulted in the committing of the second fault of his brother—stealing fire. This double fault is simultaneously the default of origin (*technē* as a counterforce), as remedy and hindsight of forgetting; it is the prosthesis of human history and also a condition of existence.[109] *Dasein*'s retrieval of truth is conditioned by this default. *Dasein*'s being is characterized by finitude or being-toward-death, which in turn conditions *Dasein*'s understanding of existence. While animals may also have this temporal finitude, the difference is that for *Dasein,* it is not only a natural death but a death belonging to my own, which is an anticipation as well as a being-alone-with. In seeing death ahead, the world reveals itself as resoluteness, a temporal ecstasy of *Dasein*'s existence. This temporal ecstasy is at the same time historical—because the "now" for me is always singular, and this singular is always historically singular. This historical singularity of *Dasein* is no less than the adding up of the "historical singular" of technical objects.

Human beings, as being under the condition of the anticipation of death, must subsequently externalize their memory in technics, that is, through language, writing, tools, and gestures. Technics then embed the human past as the already-there. This already-there is cultural memory, something we inherit but never experienced, which nonetheless constitutes the default of my knowledge and experience. The second expression of tertiary retention is technical objects—and in our case, digital objects. We write, we take photos, we make audio recordings and videos, we build social relations that can be materialized as links on Facebook. These tertiary retentions also constitute my primary and secondary retentions, just as the gramophone allows for the live performance to be played for a second (or *n*th) time. As part of our discussion of digital objects, we can locate another dimension of the "past," besides that of habitual time, as being constituent of cultural memory. This is, however, also itself a *programmable memory* that largely distinguishes between the technical objects of Simondon and Heidegger and digital objects as the technical *milieu* and programmable *context.* This gives us the second "given" of the word *datum* (the first referring to sense data). We finish this chapter with an example of our experience on YouTube to illustrate how the milieu has taken on a different role, and to prepare us for the next chapter.

I move the mouse and click on a link—a link suggested to me as a default link on the index page of YouTube. My clicking action then leads me to a page where the video subsequently plays, and the pictures and images also appear. I then notice that there are several other suggested links to other videos that have been posted by other authors—several links telling me about related videos, including some data relating to statistics such as ratings and comments. While I am viewing all this, my attention is split between the video and all the peripheral displays, with the consequence that I go back and forth between them all the time. I then notice a related video that has an interesting title, and my attention totally shifts to the details of this video—its title, its small thumbnail screenshot, the number of times it has been viewed. Then I withdraw my attention from anything else I was previously engaging with as I try to discover what the relation is between this video and the one I was previously watching. I then click on this link that has grabbed my attention to watch this new video. My actions on YouTube can be clearly analyzed in terms of the movement from a pre-predicative experience, to thematization, and then to horizons. But the question we have not considered here is the givenness of the objects. We can consider another example that helps to clarify this point. Let's imagine that a man, seeing a piled-up rope in the corner of a dark room upon entering, suspects it of being a snake. The situation is simply a given that cannot be elucidated through reflection. The subject is the core player who doubts, fears, and interprets. Finally, the man may not be able to judge definitively, and he will need (as a result) to use a stick to touch the rope to see if it is a snake. However, in our case, the givenness is actually a "passive" synthesis of the system or an intelligent agent according to the input I assigned to it. Naturally we must consider here whether it should really be called "passive"—as Cantwell Smith would possibly call it "active." Where do these situations come from? And why is it this and not that? To explain this type of interaction, we need to move from objects as relations to systems of relations.

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· CHAPTER 4 ·

The Time of Technical Systems

By the end of the previous chapter, we wanted to reunite the difference between two orders of magnitude through considering them in a state of constant materialization—passing from relations to milieux and thence to systems. We now want to seek how the gap between atomic composition and phenomenal appearance can be further bridged, as opposed to their continuing to be understood as two separable realities. This also gives us the opportunity to develop the concept of relations further. By formulating both discursive and existential relations, we want to understand the dynamic within technological developments. I must make it clear that I am not criticizing a parallel reading of Heidegger and Uexküll in terms of embodiment as wrong; rather, I want to point to another direction of inquiry, which is more concerned with technological progress than the experience of embodiment or embodied reason. The development of the theory of embodiment disturbed the dominant research paradigms in AI in the 1970s. At that time, the philosopher Hubert Dreyfus, in his book *What Computers Can't Do* (1972), launched a fierce attack on the neglect of embodiment in AI research, which he later renewed in a modified version in *What Computers Still Can't Do* (1992). At the heart of his critique was that such research took a Cartesian approach toward perception and action; in contrast, Dreyfus proposed what is now widely known as Heideggerian AI, which takes embodiment as the foundation of action. Dreyfus's critique has influenced a generation of AI researchers, including Terry Winograd, Phil Agre, and others.

To understand Dreyfus's critique and its relevance to our investigation, I briefly introduce the frame problem. In the early days of AI, Marvin Minsky, along with others, such as Herbert Simon and John McCarthy, envisaged that if we can represent the world in logical statements, all of these statements should be inferable, and the computer should be able to attain the level of human intelligence, at least in terms of common sense if not higher-level thought.[1] But Dreyfus pointed out that even having millions of representations of objects and things in the world would not be enough to solve a commonsense knowledge problem. There are two reasons for this. First, it is difficult to imagine that we can include every possible context, and second, the computer is not able to construct contexts from millions of representations.[2] The second reason is more important, because Minsky proposed a microworld view in which it would be possible to attain intelligence by limiting the domain to a set of questions. This assumption is problematic, because it misses what Heidegger calls the *Vorstruktur,* or hermeneutics of understanding: the microworld presupposes the being-in-the-world as a whole. The knowledge base will keep on increasing without fulfilling the essence of intelligence. Dreyfus thus claimed that the context problem would regress endlessly, which means that this Cartesian approach to AI is totally wrong:

> To pick out two dots in a picture as eyes one must have already recognized the context as a face. To recognize this context as a face one must have distinguished its relevant features such as shape and hair from the shadows and highlights, and these, in turn, can be picked out as relevant only in a broader context, for example, a domestic situation in which the program can expect to find faces. This context too will have to be recognized by its relevant features, as social rather than, say, meteorological, so that the program selects as significant the people rather than the clouds. But if each context can be recognized only in terms of features selected as relevant and interpreted in terms of a broader context, the AI worker is faced with a regress of context.[3]

Dreyfus's critique of the philosophical foundation of AI is very clear and convincing. Conversely, we also have reason to see the semantic web or ontologies-driven approach as being quite similar to the good old-fashioned AI (GOFAI) dating back to the 1950s. As the computer scientist Yorick Wilks pointed out,

> some have taken the initial presentation (2001) of the SW by Berners-Lee, Hendler and Lassila to be a restatement of the GOFAI agenda in new and fashionable WWW terms. . . . This kind of planning behaviour was at the heart of GOFAI, and there has been a direct transition (quite outside the discussion of the SW) from

> decades of work on formal knowledge representation in AI to the modern discussion of ontologies.[4]

This would basically allow us to repeat Dreyfus's critique for our context, that is, to argue that the ontologies-driven approach is not going to create any real equivalent of human intelligence. We should, though, make a distinction here: the agenda of the earlier AI was about simulating intelligence, whereas the current ontologies-driven Web is no longer about simulation, nor is it concerned with a specific tool or instrument, but with creating an environment in which humans and machines can interact through materialized relations. That is also why our previous discussions focused on spatiality instead of intelligence. This also marks a fundamental difference between our approach and Dreyfus's. The great contribution of Dreyfus is that he showed clearly the problem of intelligence simulation and proposed a possible solution—embodiment, which was later followed up by the neurodynamics approach developed by Walter Freeman.[5] Neurodynamics deals less with representation in the mind and more with the plasticity of the mind. It is a theory based on the materiality of neurons, muscles, hormones; but here I suggest to look at the materiality of technologies—chains, electric cables, flow of electrons, and so on, and especially URIs.

This chapter will continue the discussion of relations. Rather than simply saying that there are relations that escape materialization, such as *Dasein*'s Being, I am more interested in looking at how materialization constitutes a new structure of temporality. We have already seen that digital objects or objects in general have to be fundamentally understood in terms of discursive and existential relations. Discursiveness comes from the ability to talk. There are two types of materialization of languages: one is through writing or print, the other re-creating artificial language faculties through grammatization and simulation. Compared with the former, which needs writing tools and paper, the latter demands finer *interobjective relations.* The development from GML through HTML to web ontologies is such a process of grammatization and simulation of logical faculties, which presupposes analyticity and connectivity. With digital objects, we can see that those relations we are accustomed to viewing as at work in the mind—as in the theories of Hume, Kant, Hegel, and Husserl—are now becoming material and can be manipulated according to certain algorithms. When we consider that technological progress follows a trajectory from objects to sub-ensembles, then to ensembles, then to subsystems, and then to systems, the internal dynamic of tertiary retention transforms itself constantly according to the changes of relations between objects. If we look at the development from Charles Babbage's difference engine and analytical engine to the 1946 Electronic Numerical Integrator and Computer (ENIAC), we can easily observe that the relations between mechanical parts are replaced by electronic switches. Discursive relations become materialized and translated into contacts between objects. I would like to call this approach to understanding relations *interobjectivity.* Interobjectivity is shadowed by intersubjectivity in the philosophical tradition. In the first half of this chapter, I show how intersubjective analysis tends to reduce all motivations to the subjective understanding and ignores the technological dimensions, and I propose how to understand the technical system instead through the concept of interobjectivity. The second half of the chapter tries to understand the materialization of time as interobjective relations in a technical system and to show that it is not only mechanical time or clock time but also topological.

Intersubjectivity and Context

Intersubjectivity often refers to a collective consciousness between human subjects. Intersubjectivity becomes the common ground of cognition (hence knowledge) and feelings (empathy, morality, religion). To reach this common ground, a method is required for understanding the relation between subjects and objects. The pragmatic reading of phenomenology usually places the focus on intersubjective understanding without acknowledging interobjectivity. The human subject becomes the source of relevance, because understanding is always related to the knowledge inside the mind of the subject. Rather than attempting to address all phenomenologists, I focus here on the Husserlian phenomenological school as discussed in chapter 2. The fundamental goal of phenomenological deduction is to find this ground: the slogan "back to things themselves" in fact signifies an investigation of subjectivity by going back to the pure ego. We don't immediately reject this approach here; in fact, we return to it in chapter 5. The philosopher and sociologist Alfred Schutz's phenomenology of relevance has pushed Husserl's phenomenological understanding of context into the spheres of social and economic analysis.[6] Schutz's theory is also frequently referenced in information science to understand the notion of relevance, because the most important question for information retrieval is how to present the most relevant information from a large set of data. I would like to show how the ignorance of interobjectivity limits the adoption of his analysis for our current condition.

Schutz's exploration of a multiplicity of relevances is an attempt to analyze the polythetic structure of a context in its monothetical grasp by human actors. These two terms, *polythetic* and *monothetic,* are from Husserl, and we can once again use Heidegger's examples of the hammer to demonstrate them. When a person has never seen a hammer at all, in his first encounter, he will have to work out how to use it (if many of us today don't as often encounter a simple tool like a hammer, one could substitute something else, such as a new piece of computer software); he may, for example, have to scrutinize the handle, relate it to something else in his past experience, and so on. This way of looking at a hammer is polythetic. But when he gets used to the hammer, he doesn't have to go through this procedure; he just grasps it and hits the nail. Now his grasp of the hammer is something monothetic. In this sense, Schutz's project has an affinity with Heidegger's, and he actually refers in the text to Heidegger's ready-to-hand:[7]

> Even if I attempted to break down socially desired knowledge into polythetic steps, it may frequently turn out that these traditional, habitual items of knowledge are such only as regards the monothetic meaning pertaining to the things supposedly known, whereas the tradition which contains the polythetic steps leading to this sedimentation (i.e. to the monothetic meaning) has been lost. It may even be that polythetic steps of this kind were never performed, that the socially divided knowledge is based on the authority of a philosopher or hero or saint or the blind belief incorporated in the "idols of the tribe."[8]

The monothetic equivalence of the polythetic steps always refers to what Schutz calls the *knowledge in stock at hand.* This knowledge at the same time refers to a chronicled construction (as well as reconstruction) of past experience (social) and cognitive maturity (autobiographical and biological). Schutz actually quoted research by Jean Piaget to prove that "it would be impossible to teach a child, for instance, problems relating to causality before his general mental development has attained a level at which the underlying basic concept makes sense to him. Untimely knowledge, even of matters of fact, may lead to serious disturbances, as the case studies of psychoanalytic writers amply show."[9] Schutz classifies knowledge in stock at hand into four categories, which I summarize as follows:

1. sedimentations of our previous mental activities, for example, scientific knowledge, interpretation of problems
2. habitual possessions, including theoretical activities as well as practical thinking and acting (e.g., ways of solving problems, ways of using tools). The habitual possession is something human beings tend to ignore and forget. This is akin to Heidegger's critique of modern technology as taking for granted the *"es gibt,"* the given of its nature
3. the temporal and meaning structure of the world, or what Schutz calls "the performativity of our actions within the ontological structure of the world." The meaning structure refers to the indivisible temporal significance of human experience, for example, "phrasing" in music, when musicians have to divide the piece into different phrases to practice; other divisions, such as dividing into single notes or random phrasing, will lead to the destruction of meaning
4. knowledge we have derived from the social world, from human communication, social and cultural experience, and intersubjective understandings of being-in-the-world[10]

The human subject can access this knowledge in stock at hand according to different levels of relevance. Schutz classifies three types of relevance, namely, topical, interpretational, and motivational. Topical relevance is when something "is constituted as problematic in the midst of the unstructuralized field of unproblematic familiarity—and therewith the field into theme and horizon."[11] Schutz further classifies two types of topical relevance, "imposed relevance" and "intrinsic relevance," the former being the emergence of unfamiliarity within a familiarized environment (e.g., thunder on a sunny summer afternoon), whereas the latter is a natural change from one topic or theme to another (e.g., the user shifts her attention to an online advertisement next to her e-mail). Interpretational relevance refers to the subject's interpretation of the typicality of a certain phenomenon appearing to her by being retrieved from her conceptual field. For example, when a man sees a coiled-up rope in a dark corner of the house, he may suspect that it might be a snake and will therefore have to make an interpretation. This can be understood as what Husserl calls "explication," which is the subject's ability to direct his intention to a particular part of his pre-predicative experience. Motivational relevance is characterized in three ways, which Schutz condenses into three phrases: "because of," "interested," and "in order to." Schutz's employment of Husserl's life-world is useful to information science, but it does not go far enough to be employed in the understanding of a milieu that is highly technical.

Like Husserl, Schutz paid no attention to the problematic of the givenness associated with objects but relied on the sedimentation of knowledge of the subject, even though he had the opportunity to investigate the object more thoroughly, for example, in terms of the phrasing in a piece of music. Schutz noted that the environment cannot be taken as given but should be seen as the result of selection. This may be true when a man is walking in the forest and every scene that comes to him is always already a selected one. But in the digital milieu, the givenness is not given by nature but results from a series of calculations and interactions (which also produce bugs). The user's role in a preprogrammed context is always already anticipated, if not totally programmed. In another sense, we can still say that Schutz is right, because every ostensive communication also implies selection, but this selection doesn't entirely depend on the subject; it is initiated by a programmed givenness. That is to say, we are never in an original time but always already in an adopted time. At the end of the book, Schutz did discuss this state of ignorance:

> We live in our present culture surrounded by a world of machines and dominated by institutions, social and technical, of which we have sufficient knowledge to bring about desired effects, without, however, much understanding (if any) of how these effects have been brought about. We turn switches, press buttons, operate dials, and know as a matter of course that the bulb of the lamp over my desk will give some light, that the elevator will go up to the desired door, or that I have a good chance to hear over the telephone the voice of the party I want to talk to. . . . *Yet I remain rather ignorant concerning how these effects are brought about. I just know that "somehow" my turning the dial of the telephone sets in motion several mechanisms of one kind or another . . . and that by all these unknown or only vaguely known events I will be able to talk to my distant friend.*[12]

Yet this ignorance isn't a problem for Schutz, as he indicates by citing the following examples: putting letters into the mailbox without needing to knowing how post offices work; receiving money from work and purchasing merchandise and services without needing to become an economist; talking to a friend without knowledge of how the larynx works. This highlights the impossibility of making technical objects transparent, and one has to take these abstractions as natural; as we have seen already in chapter 3, it is for this reason that phenomenology focuses on the "phenomenon."

Context and Milieu

If we can simplify the definition of intersubjectivity as that which consists of a subject–context correlation, then its other pole, interobjectivity, has the sense of an object–milieu correlation. A milieu is different from a context: whereas a context is always a selection of significations of the subject, a milieu is more timely; it lasts, and for it to change requires a process of (re)structuralization. This structuralization moves from one material condition to another. The materialization of relations makes explicit what has been implicit, that is also to say that it reduces the distances or shortens the detours one needed in the past to carry out the same action; the multiplied explicitnesses also creates a complicity that in turn reintroduces implicitness. The reconfiguration of relations constitutes a new interface that allows human beings to access both the world and nature. This interface is at the same time divergent and convergent. It diverges because technological development has demanded an increasingly fine definition of materials and practices, which leads to constant bifurcations; it converges because human practices always override these distinctions and bring them together according to specific situations and needs. I wanted to show in the preceding passages that the traditional approach of intersubjectivity ignores the largely discursive relations materialized in objects or subordinates them to the object of recognition of intersubjectivity. Conversely, intersubjectivity is determined by a system of relevance, which is in turn the sedimentation of knowledge. This stock of knowledge at hand expressed between the interiority of individuals and ethnic groups is what Leroi-Gourhan would call the technical milieu.

In contrast to such approaches, I want to show how an analysis of interobjectivity of digital objects is possible and can supplement the analysis of culture through intersubjectivity.[13] Here I want to go back very quickly to Heidegger again on the question of intersubjectivity and interobjectivity, because I think a rereading of the concept of relation in Heidegger's thought is important in relation to our previous discussion on spatiality. Other than Husserl's approach, which focused on the subject's capacity for reduction, Heidegger proposes to understand subjectivity through time, because time is historical and *Dasein* is always historical being. Time can be privated (i.e., subjected to privation), for example, when I am asked "do you want to go out tonight?" and respond with "I don't have time." I do have time, but I private my time, and I make it my own time. But by the end I am in time, in historical time, because *Dasein* is always historical. This hermeneutic view of time puts historical events in a much broader and more profound network of causalities compared with a chronicled record of history. Hence intersubjectivity is always historical and cultural. Husserl and Heidegger provide two understandings of intersubjectivity. For Husserl, intersubjectivity finds its epodeitic ground in the substantive pure egos; for Heidegger, intersubjectivity finds its ground in the thrownness *(Geworfenheit)* of *Dasein* in history.

What is profoundly different between Husserl and Heidegger in my reading is not that Husserl's phenomenology is categorial while Heidegger's is temporal but, as I will suggest, one can find an ambivalent yet profound understanding of interobjectivity in the thought of Heidegger. *Tout court*: if intersubjectivity is expressed as the grammar of the monadic egos of Husserl or the grammar of *Zeitlichkeit* of Heidegger, then at the center of interobjectivity is the grammar of relations between objects, which gives us both *Geschichte* and *Geschichtlichkeit.* We have seen in chapter 3 that Heidegger immediately rejected the possibility of a philosophy of relations: how, then, can we still regard him as a thinker of interobjectivity? Moreover, we constantly have to confront an endless metaphysical question: what is a relation? Everything could be relational, even time and space. We have also proposed to approach discursive relations from the perspectives of Hume and Russell, who understand objects through relations instead of accidents and substances. Hence for Hume, as we have seen, relations are the foundation of objectivity and, consequently, of interobjectivity. We have also exposed the insufficiency of Hume's relations and arrived at a distinction between discursive relations and existential relations. Humean relations are noetic because he wants to use them to speculate on how the mind works. Through interobjectivity, we can analyze social relations, not through social interactions, but through materialized relations in the technical system.

My understanding of interobjectivity has two parts. First, it refers to the *materialization* of both internal and external relations of objects. A general tendency of technology consists in the materialization of all sorts of relations by rendering what are otherwise invisible elements or aspects in *visible* and *measurable* forms. This materialization also implies a schematization that resolves certain problems or obstacles. For example, when we formulate a mathematical problem, we need to draft and draw on paper to materialize thoughts in traces, after which we can reorganize these traces to go further. Time can also become a temporal relation for machines: for example, the alarm clock set at 7:00 A.M. can wake you up, but this temporal relation is composed neither of feelings nor of sensitivities but rather of material contacts; in earlier times, these contacts would have been between gears and wheels, and now they are between oscillations of quartz and signals. The history of interobjectivity unfolds itself in different stages of technological development; it is also the history of the development of its language proper, which shouldn't be immediately analyzed in terms of syntax and semantics. Interobjectivity moves from immaterial to material, sacred to profaned, intangible to tangible. The second dimension is that materialized interobjectivities create their own milieux that connect both nature and artifacts. If Uexküll's tick gives us the basic concept of milieu, it is nevertheless a primitive one (as Simondon terms the primary categories in contrast to those of mental images and symbols[14]) that is constituted by nature. Human beings construct and use tools that prolong their sensibilities. At the same time, tools become systems and create their own milieux.

Interobjective Relations

Gilbert Simondon is probably the most systematic thinker of interobjectivity. Let us revise two examples we discussed in chapter 1 to illustrate the preceding two points concerning interobjectivity. The first is the evolution from the diode to the Lee de Forest triode and then to the tetrode/pentode. The diode is a device that controls the flow of current in a single direction. In its simplest form, within a vacuum tube, the cathode is heated and hence activated to release electrons. The anode is positively charged so that it attracts electrons from the cathode. When the voltage polarity is reversed, the anode is not heated and thus cannot emit electrons; consequently, there is no current. A triode places a control grid between the anode and the cathode. A DC current can give a bias to the grid: if it is negative, it will repel some of the electrons back to the cathode and hence serve as an amplifier. A tetrode puts a screen grid next to the control grid so as to control the rate of amplification. Interobjectivity is produced here by the contacts of electrons, and through a schematization, they can be effectively controlled.

In relation to the second point concerning the milieu, Simondon often spoke of the Guimbal turbine (named after the engineer who invented it), which, to solve the problem of loss of energy and overheating due to the Joule effect, uses oil to lubricate the engine and at the same time isolate it from water; it is then also possible to integrate a river as the drive and the cooling agent of the turbine. The river here is the external milieu for the engine, but it also establishes relations with it, for example, the contact surfaces. This relation is materialized in the realization of the engine. In digital objects, we see another type of materialization, through virtual relations determined by representations and controlled by automation. We have looked at the first markup language, GML, which was invented to solve the problem of incompatibility between different software while they are computing the same object. GML resolved the compatibility issue by producing a common object for different software; the emergence of the relational database in the late 1970s and 1980s resulted from an effort to solve the same problem, but at that time the concept of a digital object was not yet concretized. The further development of metadata standards, such as HTML, XML, and web ontologies, since the 1990s has broadened the use of digital objects so that they can be used at whatever place and time and by any web-based tools.

Interobjectivity is a reality as well as a constantly motivated (improved) medium that can resolve the incompatibility between different systems (including human and technical systems). This is not immediately evident. I would like to unfold the basis for such an understanding through a reinterpretation of Heidegger's 1949/1950 article "Das Ding" and Simondon's exposition of the emergence of technical objects in *Du mode d'existence des objets techniques*. In the early stage of interobjectivity, data are always given. The givenness of data is also the givenness of the world. Our experience of the world is always experience with something given, not only something physically standing there but also something given to our perception, which constitutes the primary source of our experience. Human beings and objects of experience should not be posed as oppositions, as Heidegger says of the *Gegenstand.* Instead, they should all be understood in terms of being-in-the-world, that is, with a sense of their togetherness. After describing actual technological developments—televisions, radios, airplanes—Heidegger wrote that today the distances between places, people, time zones, are disappearing because of technological advancements. He then questioned, however, whether this disappearance of distance really means nearness, asking,

> What is happening here when, as a result of the abolition of great distances, everything is equally far and equally near? What is this uniformity in which everything is neither far nor near—is, as it were, without distance? Everything gets lumped together into uniform distancelessness. How? Is not this merging of everything into the distanceless more unearthly than everything bursting apart?[15]

Heidegger proposed to go back to *das Ding.* The thing is not the object that we contemplate by using our everyday categories. Instead, Heidegger provokes a new set of categories to unfold the thingness of a thing. My interpretation is as follows: Heidegger shows that thingness can only be thought in terms of relations pertinent to its milieu; there is no longer objectivity as such but rather interobjectivity. This interobjectivity is characterized by the fourfold *(Geviert),* which Heidegger illustrated through reference to the example of a jug, where he inquired into its essence: the jugness of the jug has to be understood in terms of the earth *(Erde),* heaven *(Himmel),* the divine *(die Göttlichen),* and mortals *(die Sterblichen).* The secret of the thing *(Ding)* is that it cannot be posed as something standing against—*Gegenstand*—but should be understood rather as a gathering of beings in which Being reveals itself. The most important difference between an object and a thing for Heidegger is that a thing stands on its own, whereas an object stands against; a thing gathers, an object sets up distances. The word *Ding* comes from the old German word *dinc,* which also means gathering for certain purposes like celebrations and ceremonies:

> Neither the general, long outworn meaning of the term "thing," as used in philosophy, nor the Old High German meaning of the word thing, however, are of the least help to us in our pressing need to

> discover and give adequate thought to the essential source of what we are now saying about the nature of the jug. However, one semantic factor in the old usage of the word thing, namely "gathering," does speak to the nature of the jug as we earlier had it in mind.[16]

Gathering characterizes interobjectivity according to the technicity of its epoch. The thing, here a jug, that is also a technical object brings other things together from a distance. In this setting of the fourfold, there is neither subject nor object; there is only *Dasein,* who exists among other beings as part of the gathering. This being part-of-an-event *(Ereignis)* disrupts the Cartesian subject–object configuration. It could be the first theoretical exploration of interobjectivity as well as a philosophical effort to return to the magical moment of existence through artifacts. How could a digital object be understood as fourfold? It may be possible, but then what would this really mean? That is to say, the fourfold shouldn't be considered a rule that we can apply to things; on the contrary, it should be posed as a way of thinking about interobjectivity. To make this clearer, we need to go back to a hypothesis about the history of technology put forward by Simondon. Simondon wanted to outline a history of technology departing from the primitive magical moment. In ancient times, magic was pretechnological and prereligious. There was no distinction between subjects and objects; as Simondon put it,

> the magic mode of relation to the world isn't at all lacking of organization: in the contrary, it is rich in implicit organisation, attached to the world and to the human; the mediation between human and the world at this point isn't yet concretized and constituted of specialized objects or human beings, rather the meditation exists functionally in a first structuralization, the most elementary of all: that which gives rise to the distinction between figure and ground in the universe. The technicity appeared as structure resolving an incompatibility: it specializes figural functions, while the religions on the other hand specialize functions of the ground.[17]

Simondon takes the concept figure-ground from Gestalt psychology, which suggests that the perception of form arises from the competition between *figure* and *ground.*[18] In this structuralization of the magic mode of existence, the distinction between figure and ground emerges while they also couple with each other. That is to say, the figure is the figure of the ground and the ground is the ground of the figure. In the primitive magical mode, there existed singular points, such as certain places and moments, that exhibited magical power, bringing human and world together. These places and moments became hubs or what Simondon called key points *(points clefs)* of reticulation. Interobjectivity—let alone the fact that the word *object* didn't yet exist in that context—operated in an invisible and immaterial manner. As Simondon said, these key points operate at a distance, as through forces that can exert influence from afar. The rupture happened when the figure was detached from the ground, when objects were separated from subject. In this instant, we observe two divergences. First, there is the divergence between the subjectification of the ground in religion and the objectification of the figure in technology. Technical objects, detached from the ground, traversed geometrical spaces and functions in whatever place and whatever time, before becoming obsolete in terms of technicity. The will to universalize technical objects requires new relations that bring objects or different parts of a technical ensemble back together—they no longer work from a distance as magical power but rather through contacts and steps:

> At the same time, the key points lose their mutual reticulation and their power to exert influence at distance on the reality that encompasses them; they, like technical objects, *only have action by contact, point by point, instant by instant.* This rupture of the network of key points frees the characters of the ground, which in turn, detach from their own ground, narrowly qualitative and concrete, float over all the universe, in all space and all duration.[19]

Despite the difference between Simondon and Heidegger, I have characterized Heidegger as a thinker of interobjectivity, because Heidegger attempted to find in philosophy a force that reattaches *Dasein,* things, and the universe, that is, through a certain trajectory of philosophical thinking, to reattach the human to the world from which it has been alienated. Heidegger's critique of the idealization of things from Plato to the technoscience of his day, which considers things as standing reserve *(Bestand),* is in certain sense genealogical, in that it outlines a problematic path departing from a fundamental forgetfulness and the exigency of a fundamental Ontology. Heidegger wants to retake the technical object, for example, the jug, as a site that allows the reattachment of the human being to the world to happen. There is a tendency to reverse materialized interobjective relations into invisible and magical relations, or as Simondon might put it, a tendency to return to the totality or unity of the ground and the figure. We may also be able to derive a similar reading from *Sein und Zeit,* when we consider that Heidegger's hermeneutic approach to the use of tools *(Besorgen)* and the understanding of historicity *(Geschichtlichkeit)* always refers to a background that is present but not present-at-hand. For example, when explaining the ready-to-handness of using a hammer, the significations come from the background, which consists of both habitual and cultural knowledge that *Dasein* cannot thematically grasp.

Interobjectivity as Technical Progress

Our interpretation of Heidegger's spatiality and temporality in chapter 3 also showed the hermeneutic relationship between context and its milieu: time in context–context in time. When we use a hammer, we are in a context of doing something, serving certain purposes; the way we use it, conversely, entails a large set of background information, such as our habits, the properties of that hammer that were made to fit certain purposes, and our relation to the hammer. Hence, for Heidegger, the temporal ecstasy of *Dasein*'s being is produced by the relations between the present, past, and future in the coupling between *Dasein* and its world. From *Being and Time* (1927) to "Das Ding" (1950), we can see that Heidegger also lingered in between context and milieu. In the preceding exploration of the concept of interobjectivity, we come to see that such a concept can constitute the philosophical task of understanding the world and its transformation. We should consider how the materiality of the digital further reconstitutes the concepts of time, context, and milieu within a technical system.

Simondon's approach is quite different, but he and Heidegger share the same task—they both see philosophy as the mediation that can produce convergences in compensation for the divergence of technical thoughts and religious thoughts, practices and theories. Simondon doesn't talk about ontology as a foundational ground of beings but instead proposes to think of the genesis of technical objects and the lineage of technicity and to find a way out in the process of invention. Genesis is similar to the process of individuation; it is generated from two types of incompatibilities: first, incompatibility with itself, and second, incompatibility with its milieu. Genesis is an internal dynamics of objects—also its destiny, in a certain sense:

> Figure and ground separate from each other in order to detach from the universe to which they adhered; the key points objectify, only they conserve their functional characters of mediation, become instrumental, mobile, capable of being effective at whatever place and whatever moment: likewise with the figure, the key points detached from the ground of which they were the key, become technical objects, transportable and abstracted from the milieu.[20]

Technical mediation also has to take into consideration the orders of magnitude of the objects that we are dealing with. For example, the jug acts as a mediation between the user and the liquid. The technical object that one chooses is not arbitrary, for example, it has to respect the order of magnitude of liquid. We won't be able to carry the liquid with a colander. As Simondon showed, these different technical objects—for example, a jug and a colander—contain certain technical mediations of interobjectivity. This interobjectivity is not a general term but has to be understood in terms of different orders of magnitude, for example, in terms of the difference between the order of liquid and powder and that of rocks and trees, while technics is the search for a solution that mediates the incompatibility caused by different orders of magnitude:

> These different mediations have a common essence as system of adaptation; the molecules of liquid or the grains of powder are of an order of magnitude that don't allow them to be effectively manipulable by the human body without an intermediate object which holds billions of them in unity.[21]

Heidegger also talked about the jug as the mediation that distributes and holds wine for humans: "how does the jug's void hold? It holds by taking what is poured in. It holds by keeping and retaining what it took in. The void holds in a twofold manner: taking and keeping. . . . The two fold holding of the void rests on the outpouring . . . to pour from the jug is to give."[22] The essence of the thing is its power of reunification across distance. This interobjectivity that could be united in *das Ding* from a distance is—as we have seen in the quotation from Simondon—slowly replaced by contact, instants, and so on. Aristotle's hylomorphism for Simondon has already moved far away from primitive magic thought and gives the "primary intuition" of technical experience *(expérience technique)*:

> The way in which Aristotle describes the relation of form and matter, which supposes in particular the aspiration of the matter towards the form (matter aspires towards the form as female toward male), is already removed from primitive magic thought, because this aspiration can only exist if there has been a preliminary detachment, whereas it is a sole being that is at the same time matter and form.[23]

I would like to suggest that the genesis of technical objects can be seen as the invention of a new interobjectivity that tries to materialize relations between objects and resolve the incompatibilities of the interior and exterior milieux. For Simondon, invention is not something that comes from a genius at a random historical moment but rather always corresponds to a problem, which is an interruption or discontinuity posed by a technical obstacle and acts like a barrier to progress.[24] Simondon is certainly one of the pioneers who looked into the genesis of interobjectivity through the lens of compatibility by strolling through the phylum of technical objects, ranging from elements, objects, and ensembles to individuals, milieux, and systems. In the same passage, Simondon referred to Heidegger: *"the thought that recognizes the nature of technical reality is what, going beyond the separated objects, the utensils, according to Heidegger's expression, discovers the essence and the impact of technical organization, beyond separated objects and specialized professions."*[25] The development of data schemes, ontologies, and protocols brings objects and users closer to each other and shortens the temporal and geographical distance involved in information acquisition. It brings us a new convergence by which we can talk about the internet of things, social media, and so on. This totality we can call a technical system.

From Milieu to System

The ultimate expression of interobjectivity is the formation of technical systems that traverse all spatial and temporal obstacles. But this also poses a problem, because interobjectivity becomes a force that leads nowhere, just as Heidegger said at the very beginning of the 1950 article "Das Ding" that the elimination of distance doesn't mean nearness—if we understand this nearness as a mode of convergence signified by the double sense of *Ding/dinc.* What then is a technical system, and how could we conceptualize it regarding the digital milieu? Milieu and system are two different concepts and have to be distinguished because the proliferation of the term *technical system* designates a significant moment in technical progress as well as the thought of technics. Mathieu Triclot, in "Technical Milieu—Genealogy of a Concept," proposed that the term *technical milieu* has been slowly replaced by the term *technical system.*[26] More precisely, according Triclot's analysis with Google tools (though the accuracy of the findings of such a method may be doubtful), after the Second World War, the term *technical system* in the French-speaking world became increasingly popular only until 1968. After this, its usage dropped to a minimal level, and it only began to become popular again in the 1980s, since which time it has almost replaced the term *technical milieu.* We may speculate about quite a few factors that may have contributed to this phenomenon. One of these is the fact that the milieu resists analysis (with the exception of Simondon's associated milieu, which we pick up again in chapter 6). Compared with the technical system, the milieu is an abstract concept, in which relations are referential, whereas in a technical system, relations and structures are much more concretized. But the question that is more pressing for us is, what is signified by the emergence of the concept of the technical system? My understanding of the technical system is inspired by two French thinkers, the historian Bertrand Gille and the philosopher Jacques Ellul.

Ellul used the word *le système technicien,* which was translated as "technological system," though it literally means "technician system." Gille uses *le système technique.* Both these original terms are actually broader in scope than the common translation "technological system." I think in fact that *le système technicien* may even be better for capturing our contemporary situation, because our culture is increasingly becoming one of technological engineering. The choice of any of these terms may give rise to confusion, especially because, for certain historians, the technical system has always existed. The reader should note that for our discussion here, the translation "technical system" is prioritized, because I want to contrast a technical system with a technical milieu. Ellul's dynamic technological system was heavily influenced by Simondon as well as by other thinkers, such as Talcott Parsons and John von Neumann. From Simondon's *Du mode d'existence des objets techniques,* Ellul took up the progress from objects to ensembles, thence to subsystems and then systems, as the base of his own theory:

> The technological object, becoming detachable, can be grouped with other technological objects according to such and such an arrangement: the technological world offers an indefinite availability of groupings and connections. . . . Constructing a technological object means preparing an availability: the industrial grouping is not the only one to be realized with technological objects—we can also realize nonproductive groupings, whose goal is to attach man to nature through a regulated concatenation of organized mediations, to create a coupling between human thought and nature. The technological world intervenes here as a system of convertibility.[27]

Ellul proposes that to study a specific technology, we cannot take it only as a tool but rather should approach it as a technical system.[28] A technical system does not simply group its elements in a random manner but follows certain causalities and constitutes its own totality. The technical system evolves according to its own logic as if it has a kind of existence in itself. Technology is gradually "organizing itself as a closed world,"[29] and the process also eliminates nontechnical factors.[30] Yet one can find an isomorphism between different technical systems. At least on this point, we may observe that Ellul's understanding comes from a parallel reading of Simondon's technical evolution and von Neumann's self-reproductive system. Similar to Ellul, Bertrand Gille developed the concept of a technical system as a group of technics that depend on each other and maintain a certain coherence among themselves:

> All the technics are to diverse degrees dependent on one another, and there needs to be a certain coherence between them: this ensemble of the different levels of coherence of all the structures, of all the ensembles and of all the procedures, composes what one can call a technical system.[31]

Gille's concept of the technical system comes partly from Ellul. In fact, Gille, in the article "La notion de 'système technique,'"[32] criticized Ellul's ignorance of another aspect of the technical system. Gille argued that one should approach the system through both its static and dynamic aspects, while Ellul only emphasizes the dynamic side, for example, self-reproduction. The static aspect of the technical system comprises structures that guarantee the internal coherences of different subsystems, ensembles, and objects. Thinking in this way, Gille's analysis is closer to ours on digital objects, because the internal coherence depends so much on the standardization of technical infrastructures. Interobjective relations in a technical system need to be coherent so that each part affects every other. For Gille, it is better to discuss the compatibility of systems than their isomorphism; indeed, some systems may be able to connect to other systems, but this compatibility cannot be taken for granted. The difference between Ellul and Gille lies here, in Gille's emphasis on the importance of a static structure as giving coherence, while Ellul focuses on the dynamic nature of a technical system that evolves by integrating referential relations into materializable interobjective relations. Here we are concerned with both aspects, because they present themselves as two orders of magnitude.

This thinking of the technical system leads us into two inquiries. First, we are concerned with the static interobjective structure of the system; second, we are concerned with the dynamic restructuration of other systems that are connected to it. Gille has shown that the evolution of the technical system always entails a brutal and violent break from the human system (i.e., its social, political, and legal dimensions) to create the coherence of the technical system.[33] In such a break, there are two consequences: first, the human system creates resistance to the evolution of the technical system, and second, the human system has to change to adapt to the technical evolution. In the case of digitization, this restructuration becomes visible, materializable; later we will see how this facilitates a thinking toward what Simondon would called a quantic jump, which subsequently produces a transductive effect.

Information Systems and the Web

Ellul in his book partly explained why the phrase *technical system* has replaced *technical milieu*. For Ellul, the decisive moment was the invention of computers and the appearance of technologies of data processing. This is a main influence on the decision of this book to approach the digital in terms of data rather than binary codes. How can we constitute a technical system that materializes interobjective relations in a coherent way? The answer is through computers. For example, considering an urban database, we observe that it connects together different components such as census results and water, telephone, power, transportation, and other networks. Hence, in fact, I think Ellul didn't ignore the static part of the technical system; rather, he already saw data as the most important material forms of interobjective relations that allow the connecting of different parts. The most profound reality of the digital for me is not the realization of the binary operation but rather the realization of data processing. Ellul saw very clearly that the data processing capacity of computers has far exceeded that of humans:

> Data processing solves the problem. Thanks to the computer, there emerged a sort of internal systematics of the technological ensemble, expressing itself by, and operating on, the level of information. It is through reciprocal total and integrated information that the subsystems are coordinated. This is something that no man, no human group, no constitution was able to do. The further technicization advanced, the more the technological sectors tended to become independent, autonomous, and incoherent. Only the computer can deal with this. But it is quite obvious that it cannot be one computer. It has to be an ensemble of computers working interrelatedly at all communication points of the system. This ensemble becomes the subsystem of connections between the different technological subsystems.[34]

The technical system nowadays in the English-speaking world is known as the information system. We can probably say that the decisive invention of Ellul's concept of the technical system is the emergence of the database. The computer scientist David Alan Grier showed a lineage of the development of information systems from Vannevar Bush's famous positional article titled "As We May Think," published in the *Atlantic Monthly*.[35] Bush imagined a future machine called Memex that would be more or less like a piece of equipment that uses microfilm as a storage system, such that the users can easily navigate through a large number of documents. Grier characterized this as the beginning of the concept of the information system. The concept of information retrieval didn't yet exist among those involved in the first generation of computers invented in 1940s, because they were more or less machines for calculation. In the 1950s, there were projects addressing information retrieval, notably at IBM, such as that which produced its Random Access Method of Accounting and Control (RAMAC) computer (1956). Until the beginning of the 1970s, many other practical projects were using database and search algorithms for information retrieval. But as Grier noted, it was Codd's invention of the relational database that realized the dream of the information system. Data processing enters its historical stage in the 1970s and 1980s.

Grier also notes that in a conference celebrating the fiftieth anniversary of Bush's "As We May Think," in the presence of pioneers in the field, such as Tim Berners-Lee, Ted Nelson, Alan Kay, and others, it was announced that "the WWW and the ubiquity of the Internet both in academic life and, increasingly, in commercial and personal spheres highlights the Web as the most widespread instantiation of Bush's vision." This for Grier also means the end of the information system, for, as he puts it, "if the Web was considered to be a database, it would fall well outside of Codd's framework."[36] Grier argued that the emergence of the relational database in the history of information retrieval was closely related to business models and development: "Codd developed a structure that allowed business people to focus on certain kinds of relationships. These relationships determined how businesses thought about their customers, their bills, and their employees."[37]

Grier's argument could be backed up by other examples, such as the Enterprise Resource Planning (ERP) systems that have been used for the automatization of administrative and organizational procedures in companies; one of the leading companies producing ERP software, Oracle, started as a database system. However, I don't think that there is such a separation between information systems and the Web: the Web doesn't replace information systems by eliminating the role of databases; instead, I would consider it the further materialization of finer relations as indicated by URIs. URIs are not even the hyperlinks of the 1980s and 1990s: they are smaller entities that indicate a subject, an object, a predicate (RDF). The finer division of relations also allows another level of automation. This means that the organizational structures and procedures that could be managed with a database are now further divided into finer materializable interobjective relations. For example, when we talked about the dataification of things, we saw how logistics companies use RFID to turn objects into manageable and traceable digital data on the Web. Another example would be the use of digital objects in social systems, such as social networking sites, to capture social relations. In chapter 6, we will also look at the realization of Jacob Moreno's sociometry on Facebook as a means of capturing social relations in terms of digital objects.

Time as Interobjective Relation

Commenting on the emergence of technical systems, Ellul wrote, "It acts upon time, it produces time to the detriment—one I could say—of space. It creates time for man while reducing space."[38] Time is at the same time discursive and existential. It is probably fair to say that time is a core relation of interobjectivity, and we can also observe the transformation of the world through the lens of time, thus posed here as interobjective relations rather than a pure flux or a subjective experience. We could probably derive a materialist interpretation of Heidegger in juxtaposition to the dominant existential readings. Pouring the wine out of the jug is an act of giving, a gift.[39] Time is always given as a gift, and this givenness has to be united, gathered in a manner that allows us to experience the profoundness of its existence, both for itself and in itself. To further clarify this point, we may pose another question: is there time in *das Ding*? Or is the temporality of the thing actually a subjective attribute? That is to say, is time objectively present inside the thing, or is it mind-dependent? We have seen that the philosopher Bernard Stiegler attempts to understand technics in terms of time or the tertiary retention. Time is just like space; it is not within the object, nor is it within the subject. Time is both the existential relations that define the finitude of *Dasein* and its everyday being and the external relations that are spatialized in technics. In comparison, Simondon was very clear on this point; when discussing the individuation of crystals, he wrote, "One could say that time is also relation, and there are only asymmetric veritable relations. Physical time exists as relation between an amorphous term and a structured term, the first being the carrier of potential energy, the second of an asymmetric structure."[40] Time acts as the relation that joins the two together, as the mediation of a casual link as well as a quantic jump; in this shift, what is amorphous becomes material and concrete.

Heidegger proposed a similar inquiry when he wrote, what is the past of the antiquities preserved in a museum? The tool was something ready-to-hand, but now it is something present-at-hand. Heidegger's question about the historicity of antiquities problematizes his explanation of the ready-to-hand in division I of *Being and Time*:

> By what right do we call this entity "historical," when it is not yet past? Or do these "Things" have "in themselves" "something past," even though they are still present-at-hand today? Then *are* these, which are present-at-hand, still what they *were*? . . . What, then is the past in this equipment? What *were* these "Things" which today they *are* no longer? They are still definite items of equipment for use; but they are out of use. Suppose, however, that they were still in use today, like many a household heirloom; would they then be not yet historical?[41]

In the same passage, Heidegger answers the question "what is 'past'?" by saying "nothing else than that world within which they belonged to a *context* of equipment and were encountered as ready-to-hand and used by a concernful *Dasein* which was-in-the-world."[42] In other words, the past—that is, time—cannot be analyzed without referring to the relation between *Dasein* and its milieu; the ancient tool in the museum is called historical because it is removed from the world of the actual *Dasein* as ready-to-hand. The "was" suggests that interobjective relations cannot couple with the habits or knowledge of *Dasein.* This decoupling is due to the coming to pass of certain interobjective relations. The materialized contacts between steam and pistons, pistons and steam jackets, gears and chains, are displaced by other types of relations. It is true that the object shows itself as a tool in the context of its belongingness to equipmentality. An object enters different systems (technical, social, economic, political) according to different orders of magnitude. A hammer doesn't just signify itself as something that is ready-to-hand but is also a commodity for Marxists, a product created by multiple machines and workers and combined by a network of resources that comes with different means of logistics. Objects are more durable than *Dasein*—as Simondon said, they are atemporal and universal. Even though they may have a life-span—being popular for some time—due to fashion, for example, they are immortal, as the poet Horace says: *"Non omni moriar."*[43] We see the multiplicity of time in the object as that which presents what is past and what is past to *Dasein,* which we call existential relations. The meaning of the object is always related to the specific milieu and system in which it dwells, but this meaning can be constituted, whereas it cannot be reduced to phenomena (e.g., the comparison of relations of different attributes, contacts) nor to pure temporality.

Time in Technical Systems

Heidegger's contextualization of both tool and *Dasein* in a specific epoch of human history is also a contextualization of them in a technological system that evolves over time. The equipment from a previous technological system is no longer usable in a new system, for example, the floppy disks that were once essential to every computer user are today totally obsolete. The past for Heidegger is not the perception of time but the incompatibility between *Dasein* and the instruments at hand. Now the question that interests us here is not the perception of time but rather the mode of existence of time in technical systems, whereby it renders obsolete some interobjective relations in favor of others. The presence of time in a technical system is not homogenous, as Heidegger describes clock time. Instead, clock time is only *one* of its possibilities. We will see in the following sections three interpretations of time in its material condition, including clock time, logical time, and topological time.

Clock Time

The clock time that Heidegger criticized in *Being and Time* is only one mode of existence of time in a technical system that serves the function of synchronization. In a technical system, the synchronization of technical objects is always triggered by different causalities. For example, in a bureaucratic system, we always need to wait for a document to be passed to the right person. Within a digital system, we similarly have to synchronize with machine time. The computer scientist inspired by Heidegger, Philip Agre, illustrated this with an AND gate: the abstraction is the truth value of an output produced when two inputs are fed into the gate. The abstraction virtually doesn't have time. Or, if it does, it is always the time of the instant. It is implemented by the physical arrival of the signal, which depends on the length and resistance of the line.[44] Consider a much more complicated circuit that consists of many different electronic gates: the implementation (physicality) and the abstraction have to be synchronized; otherwise, incorrect outputs will be produced and the whole circuit will be in chaos. This synchronization can be implemented by a "clocking regime":

> Clocking schemes can become arbitrarily complicated, but the simplest one is called a "two-phase non-overlapping clock"; it signals tick, tock, tick, tock, tick, tock, . . . for as long as the circuit

> is running, where tick means "Let us give the circuits some new values on their inputs" and tock means "Let us assume that the circuits have had sufficient time to settle down and that, consequently, their outputs are now consistent with their inputs."[45]

The clocking regime controls the physicality of the computer system. It is abstract time, which is distinguished from what Agre calls "real time." The latter is "real" in the sense that it is human time. In this decoupling, the abstract time also dominates "real time," for example, waiting. The parallel between these two systems of time points to a standardized clock time, which is used to control the physicality of the system, for example, synchronizing geometrical distance. This synchronization at the same time gives us the illusion of nearness that was at the center of Heidegger's critique. We could further investigate different orders of magnitude regarding synchronization. Let's now look at the first level. Today, teleconferences between people in different parts of the world can be synchronized by Coordinated Universal Time (UTC) or Greenwich Mean Time (GMT).[46] To synchronize, there must be a universal standard that breaks the barriers of spatial and cultural limitations. Such standards are today the forces that shape the technological system in its various dimensions. The semantic web standard, as we have seen, is one of these forces; it attempts to integrate with other forces in the name of interoperability and to consolidate the digital milieu as a unified technological system. This process of integration is at the same time the self-transformation of technical systems.

With this universal equivalent, difference can be eliminated by standardized transformations. Today, with the UTC standard, one can ignore geographical or cultural differences; for example, central Australia is not aligned with GMT, but we can now ignore this fact in an international teleconference meeting. In general, we can see this desire to move toward universal reduction as an attempt to bypass social and cultural differences and overcome geographical barriers. In our discussion of time, we saw that this reduction is so profound that it has reconfigured our relation with space. If we formerly understood time as a geometrical intuition that originated from the understanding of space, in the digital milieu, we are witnessing the opposite: space is determined by time, and this partly explains why the space of digital objects is unaddressable.

A quick flashback to the naval history of the seventeenth and eighteenth centuries may inform our understanding here. In the seventeenth century,[47] a major problem for sailors was to determine the precise location of their ship at sea. As we are taught today, any place on the earth can be located by its latitude and longitude. Theoretically the latitude can be calculated by measuring the angle between the sea and the sun or the polar stars using some instruments. But to do this was initially regarded as virtually impossible. Eventually, two ways of solving the problem were found: one was to make comparisons using a map of the stars for orientation, but as none of the existing maps in either Islamic or European culture were accurate, this also required expertise in astronomy. The other way was to calculate the latitude by the time difference. This is simple even for today's primary school pupil; for example, there is a five-hour difference between New York and London, and every hour is equivalent to fifteen degrees latitude, so there is a seventy-five-degree difference in total. But the problem was that the sailor had no way to synchronize this with GMT.

GMT is an abstract time: it can only be synchronized with space by the tool we now know as a clock. In the eighteenth century, the Dutchman Christiaan Huygens invented the pendulum clock. This gave hope for accurately representing time so that sailors would be able to synchronize with GMT. Unfortunately, even the most accurate pendulum clock, made by the Englishman George Graham, did not work at sea. Not until 1760, when the British technician John Harrison perfected his epoch-making clock, today known as H4, did naval navigation overcome its greatest obstacle. With the advance it made in time calculation, the East India Company was able to travel with unprecedented efficiency between India, China, and Great Britain, bringing fortune back to its country. The relation between time and space was reoriented. Clock time is now a supplement to the abstract GMT, which in turn determines geographical forms. Today it is easy to overlook the historical relationship between time and space, as though they were separate entities. When people are using the GPS, they may not realize that their location is being determined by 260 atomic clocks in forty-nine locations around the globe. Time is prior to space. In the digital milieu, we can see this technical heritage as an evolution that has continued since the project of GMT was introduced. Space is in any case derived from abstract time through the clock and manifests as two values of longitude and latitude; this geographical information is also often formalized as a digital object. This reorientation is projected from the technical system onto the human system, and in this redoubling of the who and the what, a new system is created based on the synchronization of time over telecommunication networks, which is today what one calls "real time": an interaction without delay or waiting.

Logical Time

We can now explore the second order of magnitude of time, where time is passed from indications to instructions, from one synchronization to another level of synchronization. It is best exemplified in the ontology of time proposed by the W3C concerning the semantic web.[48] The ontology of time in information systems is often based on earlier work by James Allen. What is intriguing in this specification is the concept of "topological temporal relations." I think it will be fruitful to compare this with the third order of time to be discussed here, which we may call topological time. Time in contemporary technology is commonly understood as consisting of measurable units assisting the system of synchronization or calendarity. This abstraction gives digital objects of time in the digital milieu. By the "ontology of time," the researchers of the semantic web propose to understand time according to three different aspects: (1) topological temporal relations, (2) measuring durations, and (3) clock and calendar. These three aspects originate from their practicality, but at the same time they also produce a new form of time in the perception of digital objects.

Researchers on the semantic web Jerry Hobbes and Feng Pan consider two basic units of time, namely, instants and intervals. An instant is the basic unit specifying a moment; an interval is specified by two instants, indicating its beginning and end points. Based on interval and instant, the user is able to specify first the topological temporal relations that exist between different temporal entities, for example, before, after, during. These topological temporal relations specify the happening of events as well as the sequence of their occurrence. These topological temporal relations are actually logical propositions stating the sequence of the occurrence of events. There are two categories of temporal relations: one is "before," and the other comprises interval relations, which include "intervalequal," "intervalbefore," "intervalmeets," "intervaloverlaps," "intervalstarts," "intervalduring," and so on. I will quote two examples by the authors that demonstrate a temporal relation "before" and an interval relation intEqual (equal intervals):

e.g.1 'Before'. It says for all (∀time entities T1 and T2, if T1 is before T2, it implies that there exists (∃ t1 and t2, the ending time of T1 (t1) is before the beginning time of T2(t2)

$(\forall\ T1,T2)[\text{before}(T1,T2) \equiv (\exists\ t1,t2)[\text{ends}(t1,T1) \wedge \text{begins}(t2,T2) \wedge \text{before}(t1,t2)]]$[49]

e.g.2 'intEqual'. It says that for all time entities T1 and T2, if T1 and T2 have equal intervals, then it implies that T1 and T2 are all intervals and for all time t1, the beginning time of T1 is the same as the beginning time of T2, and both of them have the same ending time.

$(\forall\ T1,T2)[\text{intEquals}(T1,T2) \equiv [\text{ProperInterval}(T1) \wedge \text{ProperInterval}(T2) \wedge (\forall\ t1)[\text{begins}(t1,T1) \equiv \text{begins}(t1,T2)] \wedge (\forall\ t)[\text{ends}(t,T) \equiv \text{ends}(t,T)]]]$[50]

Second, the duration of an interval is understood as an arithmetical calculation based on current temporal standards, such as day, hour, minute, or second. The authors also specify relationships between different intervals, for example, through the two predicates "concatenation" and "hath." A larger temporal unit is a concatenation of smaller temporal units, and a hath specifies the number of smaller unit intervals that concatenate to a larger interval. In other words, they specify the relations between members inside the set of that which constitutes the particular large interval. Third, the user can adopt the current representation of time zones and calendars into this ontology to synchronize different users and events.

Before we proceed with the analysis, I must make two remarks here. First, there are many other representations of temporalities based on different philosophies. For example, in Bergson's duration, "instants" are not logical units of time, because for him, a duration cannot be understood as a sequence of instants.[51] Second, the "topological temporal relations" are for us again interobjective relations that come from the division of time into different units and the topological relations between these units, such as before, equal, during, overlap, start, and finish.[52] These are discursive relations from which one can derive the comparison of certain properties.[53] The concept of topological time is investigated by Heidegger in *Being and Time* as a hermeneutic structure of past, present, and future. Heidegger criticized clock time as not being authentic, viewing it as a mechanical experience that delimits the temporal ecstasy of *Dasein*. Topological time refers to the existential relation that is revealed by the object in its coupling with *Dasein* (but that does not arise from *Dasein* or the object itself).

Topological Time

This topological time demands objects in which time rests, just as the past manifests itself in the incomparability that characterizes *Dasein*'s encountering of equipment that is no longer ready-to-hand. Certainly we can think about our past, about what we ate yesterday, whom we talked to the day before, but this remembering of the past is not experiencing the past in a bodily way, as in the encountering of an ancient piece of equipment in a museum. Within Heidegger's thought, technical reality is taken as "already there" instead of being explicitly interrogated. If such an experience of time relies on objects, one can also think of Heidegger's "already there" as something retrievable through such a calendar and the synchronized nature of time. Without the mechanical or digital clock, the sun, the moon, the stars, can be indicators of the divisibility of time. These imprecise measurements become a binding force that brings the landscapes and *Dasein* together. We can see here again the motif of *das Ding*. Because precision is the source of separation, technical processes would not exist without it and would be undone by a return to such referential relations (using heavenly bodies as the basis for a sense of time). Alternatively, we have to recognize the technical nature of time, which was already indicated by the observation of stars within a technical ensemble and slowly materialized and retained within a technical system. We demand a material view of time in the digital milieu, one that complicates the critique of clock time. I suggest here that we turn our attention to another concept of topological time suggested by French philosopher Michel Serres and by Ilya Prigogine, winner of the Nobel Prize in Chemistry, because I think they provide us with a more material understanding of time that is nevertheless close to Heidegger's. Serres doesn't consider time as a flow but rather as something material, which percolates:

> [Time] passes, and also it doesn't pass. We must bring the word pass closer to *passoir*—"sieve." Time doesn't flow; it percolates. This means precisely that it passes and doesn't pass. I am very fond of the theory of percolation, which tells us things that are evident, concrete, decisive, and new about space and time.[54]

Time is something to be filtered; some of it passes away, while some of it is retained in the objects or circumstances. Like a pot of food passing through a *passoir,* some percolates *(percoler),* while some passes away. However, there is still a big difference between this visual image and time, for with time, what is retained is not simply physical matter (e.g., in the form of vegetables or beans) but rather something of a specific "order." To further convey his model of time, Serres suggests this: "sketch on the handkerchief some perpendicular networks, like Cartesian coordinates, and you will define the distances. But, if you fold it, the distance from Madrid to Paris could suddenly be wiped out, while, on the other hand, the distance from Vincennes to Colombes could become infinite . . . the time we spontaneously use imitates the succession of natural integers."[55] The geometrical intuition of time as a line that runs from one end to another is metrical. Serres's topological model disrupts this intuition by arguing that time opens up, converges, explodes. Not only is the future of an event unpredictable but the propagation of time itself is unpredictable. Time itself is a network, that is to say, relations expressed in and through different objects:

> Earlier I took the example of a car, which can be dated from several eras; every historical era is likewise mutitemporal, simultaneously drawing from the obsolete, the contemporary, and the futuristic. An object, a circumstance, is thus polychromic, multitemporal, and reveals a time that is gathered together, with multiple pleats.[56]

Serres's topological time is isomorphic with Prigogine's "internal time," though Prigogine develops the latter from physics. As a supplement to Serres's understanding, Prigogine's theory points to the misconception of temporality in modern science. In his lecture "The Rediscovery of Time," which addresses the irreversibility of time in quantum mechanics, Prigogine criticized the fact that in theoretical physics, there is no place for history. He doesn't mean the history of science but rather the fact that the concept of the past always consists of the presence of time itself, which is also what we call the "technical reality." Especially for a highly unstable system, it doesn't make much sense to give descriptions in terms of trajectory because physical motion effectively becomes meaningless; yet it is possible to describe the system in terms of partitions. When it is described in partitions, we can only know it in terms of phase space rather than in its exact state, which means we have to understand it according to a different time from that of classical mechanics:

> A basic feature of highly unstable systems, which was recognised by B. Misra, is that we may introduce for such systems a new concept, corresponding to the "internal time" or "internal age." Internal time is quite different from the usual parameter time, which I can read on my watch. It corresponds more closely to the question which I ask when I meet a stranger and I wonder how old he is. Obviously the answer will depend on the overall appearance. His age cannot be read from the colour of the hair, the wrinkles on the skin. It depends on the global aspect.[57]

The stranger may show us different traces of temporality, but to estimate his age, we need to reassemble these traces. They don't correspond to a moment on the clock but rather always already correspond to a topological temporality. In the equipment that is present-at-hand in the antiquity museum, we don't see the exact past of the object (e.g., who exactly was using the tool, when exactly it was used), but we nevertheless "see" what is retained there as past. That is to say, time, owing to its divisibility and the basis for this divisibility, gives us historicity. These temporal residues in objects couple with *Dasein*'s knowledge to produce existential relations intrinsic to the context and the milieu. Percolation demands multiple objects to form a topology of time: as with a town, where time might be considered a property manifest in the different ages of the buildings but is retained in a different manner within the town as a technical system (linked by electricity, telephone, water pipes, roads, etc.). The ontology of the time of digital objects considered as a sequence of events, for example, registered in the time stamps of its creation, modification, and deletion, also gives us a third order that has to be understood as a topology of percolated time in material terms. "Topological temporal relations" have their significance in the way they allow us to grasp topological temporality in material terms. Again, this third material order can be seen as the contingency effect of particular technics. The givenness of topological temporality is associated with the topological temporal relations—the interobjective relations that previously existed in memory, in notepads, in calendars, are now ubiquitously present in all types of digital objects.

The Limit of Technical Progress and Convergences

Digital objects concretize interobjective relations and allow a system to be established: this can probably be understood as the vision of the semantic web or a web to come. They not only connect things together but also concretize time in a topological form that one can navigate. Within the digital milieu, we are living in topological temporalities that become more and more explicit and predictable. Time becomes affective, not only because it gives existential relations, but also because it becomes more and more discursive and precise. The central point of this chapter is that intersubjectivity as a means of cultural analysis can be supplemented by another pole: the study of interobjectivity through a systematic understanding of relations and the process of materialization. A system cannot be established without the materialization of interobjectivity and without structures that render these relations coherent. Rendering coherent is also a process of synchronization; to give a simple example, the action of the finger upon the keyboard would not produce the desired effect if there were no materialization of the relation between the key, the value of the key, the register, the accumulator, the cathode rays, and the screen. The analysis of interobjectivity implies the displacement of intersubjectivity, moving from a subject-centered discourse to a more object-centered approach: the Cartesian subject characterized by "I think" and the Humean subject who says "I compare" are slowly dissolved in technological development and are integrated as a function or functions of the technical system. In an article titled "The Limit of Human Progress," responding to an earlier article of the same title from the philosopher Raymond Ruyert in *Revue de métaphysique et de morale* (1958), Simondon sees the shift of systems as having gone from a system of man-language to the system of man-religion and now moving to a system of man-technics. For in transitional phases, humans found more resonances internal to the system, from language to religion and now to technical objects. Resonance means that there is a process of internalization and systemization that constantly concretizes what has been meditative and modifies the relation between human beings and the world (from language to religion to technical objects). Simondon hence commented on the systematization of technics:

> The real centre of systematization shifts. At first it is to be found between man and the objective concretisation. Little by little, it is

> the objective concretisation alone which constitutes the system. Man is ex-centred, the concretisation mechanises and automates itself; language becomes grammar and religion theology.[58]

Time is artificially constituted in a technological system, but it is nevertheless the reality that we live. Synchronization resulting from the development of concrete and material interobjective relations presents us with the danger of freedom, because we may ask: being in a more and more concrete technical system, does it not necessarily imply being in constant control? We can see this question of the relation between technicity and control being asked in different ways by different thinkers, notably through Deleuze's societies of control and Heidegger's critique of modern technologies as essentially *enframing (Gestell)*. What is the position of the human being in technical systems as such? Heidegger asked, "Where are we now? We have arrived at the insight that for the call 'to the thing itself' what concerns philosophy as its matter is established from the outset."[59] To retrieve the *da* of *Da-sein,* Heidegger offers a solution through appropriating a new kind of interobjective relation. There is a nuance to this that we have to reinstate here. At the beginning, we characterized Heidegger as a thinker of interobjective relations, because he didn't only discover the interobjective relations present in equipmentalities as significations, contacts, but also wanted to provoke a new type of interobjective relation, one that dematerializes itself, for example, in the case of heaven, earth, god, and mortals. These new relations resonate with Heidegger's interpretation of the mission of metaphysics: "thinks beings as a whole—the world, man, God—with respect to Being, with respect to the belonging together of beings in Being."[60]

It would be easy to set up an opposition between Simondon and Heidegger, but Simondon didn't celebrate the fact that humans are displaced from the center, because this also constitutes one of the conditions of alienation in which the human loses its role as the technical individual. We can identify in the thought of both Heidegger and Simondon a strong concept of convergence as a remedy to this situation: for Heidegger, it is *Ding* as *dinc,* as gathering; for Simondon, the philosophical task is to find a new way to reunite the divergence of technics and religions, theory and practice, and restore the role of human beings as technical individuals. In fact, speaking about convergence, Simondon referred directly to

Heidegger: "the thought that recognized the nature of the technical reality is the one that, going beyond the separated objects, the utensils, according to the expression of Heidegger, discovers the essence and the meaning of technical organisation, beyond the separated objects and the specialised professions."[61] But what is meant by convergence here? Simondon proposed two directions. One would be to restore the encyclopedism of the Enlightenment, whereby each individual should study and acquire a sufficient level of technical knowledge. This question concerning pedagogy has today been realized in a certain sense through Wikipedia and similar websites, hacker spaces that effectively cultivate the culture of the amateur. The other direction is that of a reconstitution of reticulation through philosophical thought, with the aim of transforming *the key points,* and hence the technical system itself, from within. It is precisely on the second point that we are confronted with the uncertainty of Simondon's thought as well as the challenge it leaves us. Because Simondon didn't live in a time when networks were so dominant as they are in ours, the network remained something to be given rather than created:

> one changes tools and instruments, one can construct or repair a tool oneself, but one cannot change the network, one doesn't construct oneself a network: one can only tie in with the network, adapt to it, participate in it; network dominates and encloses *[enserrer]* the action of individual beings, dominates even every technical ensemble.[62]

Today we may not be able to change communication networks in terms of transatlantic cables, but we are able to establish social networks, file networks, data networks, by using Facebook, Twitter, WordPress, Dropbox, and so on. But on the other hand, can we consider the realization of a technical system qua network as actually having given us the new possibility that Simondon dreamed of? Heidegger sought to find new relations by reaching outside the technical system, whereas Simondon wanted to find a solution from within. Heidegger proposed mediative and poetic thinking as a new possibility, that is also to say, a nontechnical imagination, going back to language. In contrast, Simondon, like Bertrand Gille, sees modification of structure as the ultimate possibility for human beings to rediscover the remedy within the technical system itself:

> Transforming all the conditions of human life, augmenting the exchange of causality between what man produces and what he is, true technical progress might be considered as implying human progress if it has a network structure, whose mesh is human reality; but then it would no longer be solely an ensemble of objective concretizations.[63]

In Simondon's own vocabulary, this demands a thought that seeks a margin of indetermination for the design of technical objects. It allows an ensemble with more flexibilities by leaving it open. It is necessary to think of a more perfect system than automation. Automation here means a closed system with overdetermination, and for Simondon, such is only a low level of perfection of technical objects. From the discussions of chapter 1 to the account of interobjective relations and technical system in this chapter, we have unfolded a technical reality that we are living and the technical tendency that already lies ahead of us. Now, if we understand that both Heidegger and Simondon point to a higher degree of convergence, in comparison with the one that is brought about by network technologies, then how can we imagine this higher degree of convergence in an already converged technical system? To reconsider convergence, we can no longer take the notion of network for granted as signifying convergence in its totality. Instead, Simondon and Heidegger point to types of logic that are more profound than efficient connections and reticulations: on one hand, a logic of convergence that points to an intuitive thinking beyond objectification, namely, whose role is to think about the "thingness" of the thing; on the other hand, a logic of convergence that needs to be reinvented inside the technical systems against the alienation effected by them. Hence a return to the discussions of object-logic and language-logic will be the task of Part III.

· Part III ·

Logics

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· CHAPTER 5 ·

Logic and Object

In the first two parts, we studied the concept of relations, which allows us to move away from the conception of objects as representations as well as allowing us to proceed from objects to systems. At the end of chapter 4, we left a question to be answered in Part III: the question of convergence as a philosophical task proposed by both Heidegger and Simondon. This is not only an interpretation of digital objects but also demands a consideration of the future development of digital objects. The answer is a "return to things themselves." For Simondon, this means a return to technical objects; for Heidegger, it means establishing the ontological difference between objects and things. Our solution will also be to go back to digital objects, both to their technical components and to their working principles. Hence logic, the most fundamental aspect of computation, cannot be avoided. Before us is the philosophical task of answering the following question: *what kind of logic would make it possible to produce a new type of reticulation in favor of convergence*? This is the main question of this chapter, which proposes to address it by seeking a logic of the kind that Simondon calls transductive for the conceptualization of digital objects. I decided to go back to Husserl here, not only because Husserl is the originator of the slogan "back to things themselves," but also because it will be valuable to retrieve what Husserl calls intentional logic, which was a critique of the formal logic or extensional logic of Frege and others. Husserl's effort was to develop a logic that would be both formal and intentional. The debate between Husserl and Frege has rarely been addressed in computational theory. This chapter argues that the intentional logic can serve as a point of departure for the development of a transductive logic in the sense of Simondon. This will consist of a reflection on Husserlian phenomenology, whose key gesture is undermining the pure ego, as well as (if at all possible) enacting a reconciliation between Simondon and Husserl.

Toward a Transductive Logic

If being-in-the-world has to be interpreted as being-in-a-technical-system, then Heidegger's proposition could be read as an attempt to introduce new categories, which preserve the system and present it from a totally different perspective. When we ask ourselves how to understand a jug in terms of mortals, the divine, heaven and earth, we may feel we are faced with a joke: does the jug really have anything to do with the divine? If Heidegger succeeds, he will be able to bring this theological understanding back to things. This understanding may not affect the way the jug is produced and circulated, but it will at least transform how it is perceived and handled (Zen Buddhism can give us such an example). The jug hence regains a magical power that serves as a key point of convergence. For Heidegger, to move from objects to things, which is also the basis of a critique of formal logic (as is explained in chapter 6), is the fundamental project. For Simondon, classical logic constitutes an obstacle to thinking about individuation because "it requires that the operation of individuation be thought using concepts and relationships between concepts that only apply to the results of the operation of individuation, considered in a partial manner."[1] We can understand that there is certain rigidity in classical logic, in which relations only come from a predefined concept, whereby moving from one relation to another also implies moving from one concept to another.

Such thinking is not a question of aesthetics. It seems that we can do many things with an interface; we can build different interactions within the limits of binary code, computational languages and hardware, and so on. These interfaces will produce effects that go far beyond the rigid logical limits. So are we to leave the lower-level abstractions intact as long as higher-level implementations are possible? I think this is why Simondon wants to distinguish aesthetic thought and philosophical thought, assigning to aesthetic thought the convergence effect of the primary level and to philosophical thought, because it always aims at fundamentals, the second level of convergence. For Simondon, the aesthetic impression is only effective in the first modality of bifurcation of magic power into technics and religions; in the second modality of bifurcation, where technics and religions, respectively, produced their own practical and theoretical parts, aesthetic impressions are no longer powerful enough to serve the purpose of convergence, which thus becomes the task of philosophical thinking able to engage with the technical system. Simondon commented:

> One can learn a poem, contemplate a pictorial work, but this doesn't mean that one can learn poetry and painting: the essence of the thought is not transmitted by expression, because these different types of thoughts are mediations between man and the world, and do not emerge from the encounter between subjects: they don't suppose a modification of an intersubjective system.[2]

Hence, for Simondon, instead of aesthetic thought, philosophical thought is the penetrating force that will be able to produce a convergence effect in the later stage of technological development. That is to say, it is not the perception of objects that matters but rather the modification of the interobjective and intersubjective system.[3] Philosophical thought is able to produce a force in favor of transduction, given that this thought is fundamentally *relational.* This also constitutes the task of the previous parts of this book, that is, to constitute a theory of relations. Transduction in my reading also implies convergence, which concerns the interoperability and compatibility (as well as incompatibility) between humans and machines, seeing them as a structure that is at the same time individual and collective. Transduction is not a pure becoming but rather a rupture that reconfigures the structure of both the being and its milieu. We can say that the shift from analog to digital produces transductions in different domains of society. This also corresponds to our previous discussion of the difference between milieu and context, because a change in context is a change in information, while the change in milieu is a change in structure. A change in information can trigger a change in structure, but it is not entirely correspondent to transduction in the milieu; hence in this chapter we explore this change in context as informational change, which in turn provides the motivation for a transduction.

To be more precise, transduction for Simondon means both a structural change and an amplification process. Transduction comes from the Latin prefix *trans-* (across) and *ducere* (to lead), thus meaning a "lead[ing] along or across, transfer."[4] Transduction signifies a process or an action that leads to a transformation across different domains. In fact, already in the philosophy of Descartes, the "pineal gland" serves as a transductor. For Descartes, all the stimuli are accumulated in the pineal gland before they are submitted to the soul. He thinks the pineal gland has a special position because it is the only part of the body that is not doubled (i.e., we have two of everything else—eyes, ears, etc.).[5] The pineal gland is the transductor that connects the soul and the body by translating or transferring the stimuli into the language of the soul. In engineering terms, a transducer is a device "for converting energy from one form to another for the purpose of measurement of a physical quantity or for information transfer,"[6] as in, for example, the transducer that converts cathode rays into images.

Simondon retains the technical meaning of transduction as a means of communication and transmission. Furthermore, he identifies transduction as the third way of reasoning beyond (and juxtaposing) induction and deduction, giving rise to a type of thinking that doesn't move unidirectionally from inside to outside, outside to inside, individual to collective, collective to individuals, but rather presents itself as a process of the *transformation of forms and structures*.[7] It will be also useful to think of transducer and transduction together, that is to say, to identify technical objects as transducers in the process of individuation. Simondon often uses the example of crystallization to illustrate the process of individuation. When a supersaturated solution is heated, it starts to crystallize; the ions then take on the structure of "crystallization germs," releasing energy that propagates from part to part and triggers further crystallization. Here we see two phenomena: first, a process of amplification, as the transmission of germs is sped up because of the energy released during crystallization; and second, the creation of tensions between ions, which are resolved through crystallization to achieve a metastable state:

> A crystal, which from a very small germ, grows and extends in every direction in its water-mother, provides the simplest image of transductive operation; every molecular layer already constituted serves as the structuring base of the layer in process of formation; the result is an amplifying reticular structure. Transductive operation is an individuation in progress.[8]

Transduction is a new form of convergence in the sense illustrated by crystallization. The transductive condition for Simondon always manifests in a systematic way, being simultaneously energetic, material, and informational. Transduction happens when these conditions are modified in such a way that a threshold is overcome. Transduction is essentially relational. For this reason, Simondon distinguished the knowledge of relations and the knowledge of phenomena. Meanwhile, in chapter 3, we have already seen that phenomena are themselves relations and can be extended to other relations. Our question is, if formal logic is the foundation of digital objects, can we still imagine a transductive logic of digital objects? Simondon himself is not a logician, hence to directly confront the question of logic, we need to move to Husserl, while having Simondon in the background and constantly looking for dialogues. This link between Husserl and Simondon was first made by Deleuze in *A Thousand Plateaus,* where he showed that Husserl developed a *protogeometry*—a science that deals with something "anexact yet rigorous."[9] Deleuze gives an example of roundness, which is not exact as a circle (that is, ideal), but neither is it an inexact sensible being. It is instead *anexact.* Deleuze proposes that this can be compared to Simondon's critique of hylomorphism, because both gave an *intensive* dimension to matter.[10] As we have already seen in the previous chapters, Simondon's critique aims to bring forward an operational or process thinking. Such operation takes form as one source of information, which is essentially intensive. This comparison between Husserl and Simondon serves as an invitation to mediate on two orders of magnitudes: the *sensible, formal,* and *noetic* order of Husserl and the *material, informational,* and *technical* order of Simondon. To start with, we should elucidate Husserl's position as a logician.

Logic and Ontology

The interpretation of the relation between logic and ontologies, from Aristotle onward, is rather controversial. Some philosophers see no difference between ontologies and logic in the thought of Aristotle, for whom ontology is the theory of category and logic denotes the rules of reasoning: "the principal method of ontology has been one or another form of categorical analysis, depending on whether the analysis was directed upon the structure of reality, as in Aristotle's case, or upon the structure of thought and reason, as, e.g., in Kant's *Critique of Pure Reason.*"[11] According to some philosophers, Aristotle wanted to develop a theory of being by considering both *logos* and *physis,* that is to say, through an inquiry that was both logical and ontological.[12] In both cases, it seems natural to deduce that ontology actually implies logic; for example, making a distinction between male and female already implies a logical negation, an element of reasoning that is indispensable in the thinking of ontologies. The Stoics rejected this idea of a common ground between logic and ontology, on the basis that logic comprises the rules of argument, while ontology has to do with categories and with what exists as such. The Scholastic logicians also made a distinction between the two, calling ontology "first intentions" (meaning concepts abstracted directly from physical reality) and calling logic "second intentions," because they are "concepts abstracted wholly from the 'material' content of first intentions, as well as such categorical concepts as *individual, proposition, universal, genus, species, property,* etc., and so-called syncategorematic concepts such as negation."[13] The emergence of formal logic after the nineteenth century seems to further separate it from metaphysics (though metaphysics is still a core subject in analytic philosophy).[14] Yet, when ontologies and logic are implemented on a computational machine, ontology and logic converge again, and therefore Husserl's program of binding formal logic and formal ontology outlined in *Formal and Transcendental Logic* has prepared us for our excursion.

The idea of web ontology today actually synthesizes the two: a formal logic regulates the description of what exists. According to the philosopher and logician Bochenski, formal logic is "a theory of a general sort of object" and "logic as it is now conceived, has a subject matter similar to that of ontology."[15] Especially in automation, categorization is meaningless without a logic to provide the means of enabling inference. The use of formal ontology in information science alongside that of classification also focuses on the validity and truth of statements.[16] The Web Ontology Language (OWL) proposed by the W3C is influenced by quite a few industrial standards, for example, the RDF, the frames paradigm, and, most important, Description Logic (DL).[17] DL is a restricted subset of the first-order logic (FOL) formalized by Frege,[18] the difference between them being that DL is decidable, meaning that given a logical statement, the system will be able to tell if such as statement is true from inferences. OWL is a subset of DL that preserves some of its computational functions according to their specific uses; for example, a complete DL is a powerful tool for the logician to use in verifying the consistency of the system, but it is too powerful for semantic web use.[19] The expressiveness of logical language decreases from FOL to OWL, but the syntax becomes more and more flexible.[20] OWL builds on DL and is less a theorem prover, more a proof validator: it cannot verify whether an answer is correct, but it "can follow a simple explanation that an answer is correct."[21]

Frege's intention to build a *lingua characteristica* to serve as the foundation of mathematics is a vision comparable to that of Berners-Lee of the semantic web, which he also calls a "language of logic."[22] This language of logic is not new, as it can be traced back to a range of precedents, from Frege, Cantor, Hilbert, Gödel, and Turing to Boole, De Morgan, and Leibniz. But it is only in Frege that such a language of logic is possible. Boole's logic was still a branch of mathematics to be developed by ordinary mathematical logic, whereas Frege wanted to reverse this order by rendering mathematics as symbolic logic.[23] By using an innovative method of notation, Frege developed a formal system that he called the Begriffsschrift. The Begriffsschrift is able to account for all human deductive reasoning. In his 1930 doctoral dissertation, Gödel proved that Frege's rules were complete as an answer to the question raised by Hilbert.[24] It was Turing who later took up Hilbert's *Entscheidungsproblem* and discovered the universal machine. The *Entscheidungsproblem* can be generalized as the search for an algorithm that can reduce all human deductive reasoning to calculation.[25] We go into the history of the universal machine in more detail in chapter 6; for now it is important to note that its development is more or less centered on Frege's concept and system of logic. Of course, it wouldn't be fair to say that modern logic is not very different from classical FOL or to reduce the semantic web movement to the Fregean project. For example, it is significant that Hilbert's mathematical formalism already combined Frege's logic with mathematical axioms to refine FOL into propositional logic. But in DL, the core Fregean FOL features, such as the distinction between concept and object, the meaning of *term* and of *predicate,* remain unchanged.[26]

Object and Concept in Logic

Frege's philosophy of logic is not as abstract as the symbolic systems one encounters today. Frege assigned a very high status to the concept, which for him is "something primitive which cannot be dispensed with in logic." Without a concept, there will be no class and set. So, when an object is in a set, it is already subsumed under a concept. Frege distinguishes the object-expression from the concept-expression in his Begriffsschrift: a concept-expression plays "a predicative role in the sentences in which it appears," whereas an object-expression stands "for that which is said to fall under a concept in the sentences in which it appears";[27] for example, "——is a horse" denotes a concept, whereas "Black Beauty is a horse" is a simple predicate of an object that falls under the concept:

> We can only determine a class by giving the properties which an object must have in order to belong to the class. But these properties are the characteristics *[Merkmale]* of a concept. We define a concept, and past over from it to the class.[28]

Yet the concept is not the most fundamental element of logic. In "On Concept and Object,"[29] Frege responded to a challenge from Benno Kerry and produced one of his most interesting and "paradoxical" arguments: the concept horse is not a concept. This is very significant, because for Frege, in FOL, we cannot talk about concepts but only about objects. Kerry proposed that in the sentence "The concept horse is a concept easily attained," "the concept horse" serves as both a concept and an object, because the proposition tautologically says that "a concept is a concept," while also allowing it to remain an object according to Frege's analysis. Frege rejected this counterproposal and said that "the concept horse is not a concept"; then is "the city of Berlin" a city or even "the volcano Vesuvius" a volcano? Frege recognized the "awkwardness" of his expression. Indeed, he wrote, "By a kind of necessity of language, my expressions taken literally, sometimes miss my thought; I mention an object, when what I intend is a concept. I fully realize that in such cases I was relying upon a reader who would be ready to meet me halfway—who does not begrudge a pinch of salt."[30] To mitigate this awkwardness, Frege explains that in the FOL, to talk about a concept, we necessarily have to convert it into an object or let "the object go[ ] proxy." The reason for this, according to Frege, is that in his system, a concept, unlike an object, cannot be the subject and thus subsumed under the predicate. It is very significant that in the OWL, there must be an URI to indicate the object, even if it is spoken of as though it were a concept. A digital object, for example, a YouTube video, falls within different concepts/ontologies and acts as an instance of these classes, which can then be reassembled as a "complete" object.[31]

For Frege, the concept horse when expressed in language is no longer a concept but rather an object with which we can describe. The proper name Black Beauty gives us a description of this horse. We know that it is beautiful and black. Frege set up a system of meaning in language, in which proper names are not simply denotations. Accordingly, the truth of a logical statement or a sentence for Frege must go beyond the intuitive understanding of a predicate asserting an object. The object in question is not a pure symbol. Frege and Russell's critique of John Stuart Mill focuses on the fact that Mill understands proper names as symbols that don't necessarily carry true meanings. An example is the name of the English town Dartmouth; Mill holds the view that even if the river Dart changed its course so that Dartmouth was no longer the mouth of the Dart, we could still call it Dartmouth, regardless of the meaning carried by the compound word. In contrast, Frege holds the view that names do have meaning. To differentiate relations, Frege introduces two ambiguous concepts, namely, *Sinn* and *Bedeutung*. In everyday German, these two words mean more or less the same thing: "meaning." The English translations of the title of Frege's article "Über Sinn und Bedeutung" have varied, because it literally amounts to "On Meaning and Meaning"; here we take the most common translation, "On Sense and Reference." Frege first talked about the *Sinn* and *Bedeutung* of proper names and later extended this discussion to the analysis of predication:

> A proper name (word, sign, sign combination, expression) expresses its sense, stands for or designates its reference. By means of a sign we express its sense and designate its reference.[32]

We can illustrate the difference, using Frege's own example, by considering "morning star" and "evening star." They both have the same reference *(Bedeutung)* to Venus, but they have different senses *(Sinn)*. In this way, meaning is made a matter of identity, and reference is concerned with objects. But Frege continues nevertheless to say that the reference must be prioritized as the major criterion in the accessing of logic: "The logic books contain warnings against logical mistakes arising from the ambiguity of expressions. I regard as no less pertinent a warning against apparent proper names having no reference."[33] When Frege extends meaning and reference to a sentence, we observe something peculiar. Frege calls an expression that completes the proper name a "functional expression or unsaturated expression." Consider a complete expression like "5 + 8": the sign "+" is a functional expression because it completes the expression. A predicate for Frege has the same role as a functional expression. Frege understands the predicate as an "expression got from a sentence by removing one or more singular terms,"[34] that is, removing the subject from an expression such as "—— is a horse." Now what makes an expression true? To judge is to judge something: as Frege wrote in a footnote, "a judgement, for me, is not the mere comprehension of a thought, but the admission of its truth."

The admission of a thought's truth is the reference, as Frege claims that "it is the striving for truth that drives us always to advance from the sense to the reference. . . . We are therefore driven into accepting the truth-value of a sentence as constituting its reference."[35]

Sense and Reference on the Web

The same question concerning sense and reference applies to the Web. However, our aim is not to solve this problem here but rather to understand it as another order of magnitude, hence to produce a resolution or seek a common ground. The logician and computer scientist Patrick Hayes and Tim Berners-Lee have debated this issue. For Berners-Lee, a URI can refer to anything that he calls a resource; meanwhile, for Hayes, for the semantic web or a logical system to exist, there is no immediate way of guaranteeing that the URIs pointing to the Tim Berners-Lee of thirteen years old and the Tim Berners-Lee of sixty years old are pointing to the same person[36]—two senses (ages) but the same reference (Berners-Lee). To resolve this argument, one of the researchers of the semantic web, Harry Halpin, proposes to move away from the tradition of Frege and Russell to the modal logic of Alfred Tarski, later developed by Saul Kripke. Kripke develops powerful resolution of the identity problem by introducing the concept of possible worlds. As Kripke defines, "a possible world is given by the descriptive conditions we associate with it."[37] For Kripke, the proper name is rather a rigid designator (we can also speak of weak or loose designators here). A rigid designator is defined by a cluster of descriptions. Here Kripke differs from Frege and Russell and, in so doing, critiques both logicians. For Frege and Russell, descriptions are synonyms of proper names, whereas for Kripke, a description is only one of many that contribute to the rigidity of the designator.

The possible worlds are not only temporal worlds, for example, worlds in which Berners-Lee is thirteen years old and sixty years old, respectively. We can probably also associate them with what Hilary Putnam calls the division of linguistic labors. In his article "The Meaning of 'Meaning,'" Putnam developed a critique of logical positivists such as Frege, Russell, and Carnap, especially on the point that the "meaning of a term (in the sense of intension) determines its extension."[38] In contrast, Putnam shows that words such as *gold* and *aluminum* have different meanings in different sociolinguistic domains. For example, he proposes that we imagine that there is a factory in which someone has the job of wearing gold wedding rings, someone has the job of selling gold wedding rings, and someone else has the task of determining whether something is gold. Putnam shows that we cannot definitely say someone who has the occasion to buy gold will be able to tell with reliability whether something is really gold. We could say that there are different possible worlds, and the question is rather to find an identity that traverses all these worlds. If the proper name is not the synonym of its reference, then this signifies that the object is no longer its substance nor its states of affairs. In a manner similar to our interpretation of Aristotle's relative in his *Categories,* Kripke shows that the preceding philosophical fallacy must be confronted:

> Philosophers have come to the opposite view through a false dilemma: they have asked, are these objects behind the bundle of qualities, or is the object nothing but the bundle? Neither is the case; this table is wooden, brown, in the room, etc. It has all these properties and is not a thing without properties behind them; but it should not therefore be identified with the set, or "bundle," of its properties, nor with the subset of its essential properties.[39]

In Halpin's own treatment, he sympathetically demonstrates that one way to resolve the URI identity crisis is to recognize that Tim Berners-Lee is actually (and unconsciously) a follower of Kripke,[40] because the Web allows the existence of possible worlds. I sympathetically endorse this analysis, while at the same time, I think that the question stills need to be made more precise and that the relational thinking that one can identify in Kripke's possible worlds is in this analysis largely missed. What is suspicious is the concept of the object raised by Halpin: we can easily determine that a URI doesn't necessarily indicate a proper name and its object; rather, what it indicates is rather arbitrary and can be a predicate, an object, a relation. The preceding argument regarding sense and reference in terms of the Web takes everything as an object, which we can probably identify as corresponding to the old analogy between mind and machine. For example, one can think of anything in one's mind, and by this presentation in thought, it becomes an object. In the case of thinking the number 2, the latter becomes an object of thought rather than a concept indicating quantities. Halpin's argument regarding URIs has the tendency to equate all relations to proper names. If we say "The city Lüneburg is beautiful," Lüneburg is a proper name, because it is a medieval city that has existed in Germany for hundreds of years. In contrast, "is" is not an object, and neither is "beautiful."

It is not the predicates as extensions of the object that give it its identity, nor does the thing-in-itself define the object as such; the identity arises, rather, from a family of descriptions. The URI grasps, but it doesn't grasp the entire object; it doesn't always grasp a proper name, but it always grasps relations. A URI deals with objects without differentiating its orders of magnitude, and this is why it could plausibly be called a universal resource indicator (later renamed as a uniform resource indicator). I believe there is a new metaphysics to be traced beneath this movement, entailing the abolition of all types of objects and their replacement with the name "resource," as the philosopher Alexandre Monnin has wonderfully done, though this is not our intention here.[41] A URI has intention but doesn't necessarily have intentionality—if we use this word in the strict sense of phenomenology. Indeed, I think in this misunderstanding of objects—namely, when the URI grasps the object only partially, its theorists and technicians take it to have grasped the entire object—we can trace a branch of the history of the application of philosophical logic, and this may also allow us to construct an alternative reading.

Husserl and the Critique of Logic

If we regard the Web as a technical system of materialized interobjective relations that is also constantly materializing new relations, then any investigation that subsumes itself within the framework of symbolic logic won't be very fruitful beyond contributing to a technical understanding. In this section, I would like to reintroduce the thought of Husserl. Husserl's critique of logic consists of a critique of symbolic logic that reduces meaning horizons into a short circuit. And the task of Husserl, if we can thus simplify it, is to find an embodied way to understand the relation between logic and object through a theory of experience. This brings back the notion of intersubjectivity and how it is transformed into interobjectivity to produce a new form of intersubjectivity. This shows that another type of organization of objects is possible and that it will probably be able to reintegrate users into a logical system, in other words, to bring about a convergence. The Husserlian logic seems to me to consist of another set of relations that gives us a new model for thinking about ontologies, logic, and objectivity. By the end, we hope to derive another interpretation of intersubjectivity in relation to interobjectivity.

Let's go back to the question of meaning and concept. When we say "Socrates is a man," the predicate "is a man" must be analytic with regard to the concept under which Socrates falls. Where are these meanings coming from? When we say that a sentence is true according to its reference, then how can we say that a concept is true? This doesn't seem to bother Frege much:

> Just because [grasping and judging] is a mental *(seelisches)* event, we do not have to care about it. It is enough that we can grasp thoughts and acknowledge their truth; how this might happen is another question.[42]

Frege further expresses the idea that "we are not owners of thoughts as we are owners of ideas. We do not have a thought as we have, say, a sense impression, but we also do not see a thought as we see, say, a star." Thought *(Gedanke)* for Frege is close to *Sinn,* both of which are idealities that don't appear to us and remain ungraspable. We can probably say that there is virtually no experience for Frege that also holds for a computer. The greatness of formal logic is that the truth is unconditioned by any interpretation, but this is also its weakness, in that it is not able to incorporate an operational logic. Modal logic à la Alfred Tarski and Saul Kripke has loosened the limits set by Frege and Russell: the possible worlds liberate the synonymous relations between a proper name and its references. Now, if we turn to Husserl, can one imagine what computer science would be if Husserl had been read instead of Frege? Is this a thinkable question? Husserl is not a sign that we can substitute in a proposition. If Husserl were read instead of Frege, Hilbert's *Entscheidungsproblem* would not have been posed, and Turing would never have arrived at the universal machine. Husserl is a world, but not a sign. Similarly, Adam and Eve cannot be substituted for Peter and Mary, because Adam and Eve, like Odysseus, are rigid designators. Is this a meaningless question? Analytically, there is meaning in this sentence, as the question is understandable. But it is also meaningless, because such a world is unthinkable if we designate the word *meaning* to refer to something actual or real. What is the meaning of a predicate? Where does it come from? In contrast to Frege's *Sinn* and *Bedeutung,* Husserl's phenomenology is nothing less than a project to attain the clarity of these relations through the understanding of experience *(Erlebnis),* as he stated clearly:

> In order for the substrate of the explication to become a subject and for the explicates to become predicates, it is necessary that the regard turn back to the unity which is passively pre-constituted within the receptive activity of the process of explication and is in a sense concealed.[43]

Husserl took up the relation between logic and predication in his *Logical Investigations,* and it attained maturity in *Experience and Judgement, Formal and Transcendental Logic,* and *The Crisis of European Sciences.* Husserl proposed in his *Logical Investigations* to search for a method of pure logic. Such a method has two significant criteria for Husserl. The first is anti-psychologism. On this point, Husserl and Frege are together. Indeed, Frege was very critical of Husserl's first book, *The Philosophical Foundation of Arithmetic,* and accused him of psychologism. Husserl's response to this criticism is contained in the two volumes of his *Logical Investigations.* Psychologism was a popular approach to logic at the time. Its premise is that psychic acts are real events and that the laws of logic reflect the way the mind and the human psyche work, hence it "reduces logical laws to empirical laws."[44] The problem of psychologism lies in its confusing of the real and the ideal. Frege terms this problem *epistemological idealism*:

> Psychological treatments of logic . . . lead(s) then necessarily to epistemological idealism. Since all knowledge is judgemental, every bridge to the objective is now broken off. This flowing into idealism is most remarkable in physiology, because it is in such sharp contrast to its realistic starting point.[45]

Frege's critique of psychologism is firmly grounded in his belief that logic cannot be derived from any individual experience or mental state. Logic has to be pure and analytic if it is to be the foundation of thought. What is most interesting here is that Husserl on one hand endorsed the fact that logic has to be apodeictic (one should recall that *Logical Investigations* is a work undertaken to prepare an "unshakable, absolutely unquestionable foundation of knowledge" to defend the certitude of logic against relativism, skepticism, historicism, and psychologism[46]—when Husserl was writing *Logical Investigations,* he apparently already had Leibniz's *mathesis universalis* in his mind), while, on the other hand, he also advocated the fact that logical judgment has to be experiential judgment[47] and that his philosophy does not advocate an "objective philosophy" but a transcendental philosophy. An immediate question is, how can experiential judgments guarantee an objective truth at all? We can say that Husserl dedicated his whole career to searching for an answer to this question—to seeking for a way to make transcendental philosophy the foundation of a rigorous science able to overcome the crisis of the European sciences. We have to admit that there are different Husserls, and the late Husserl is quite different from the early Husserl. For example, in *Crisis of European Sciences,* we find Husserl continuing to engage in a critique of the modern appropriation of *mathesis universalis,* as he has already outlined in his programmatic of *Formal and Transcendental Logic* (see chapter 2). But this notion of transcendental philosophy had been already significant in the second volume of *Logical Investigations.*

We have to clarify the term *transcendental* here. *Transcendental philosophy* is a term generally associated with Kantian doctrine. For Kant, *transcendental* means a priori but retrievable, for example, the knowledge that 4 + 4 = 8 is a priori, because it is not an empirical creation. Kant finds the foundation of knowledge to be the pure, the a priori. Husserl criticized Kant's inability to develop a truly transcendental philosophy owing to his uncritical attitude toward the a priori. For Husserl, Kant only goes halfway and is actually "far away from accomplishing a truly radical grounding of philosophy."[48] Husserl is thus distant from the brand of neo-Kantianism that seeks the foundation of science in Kant's philosophy. Husserl wants to go further and do what Kant did not and could not do by grounding knowledge in a truly transcendental philosophy. For him, transcendental philosophy is the

> motif of inquiring back into the ultimate source of all the formations of knowledge, the motif of the knower's reflecting upon himself and his knowing life which all the scientific structures that are valid for him own purposefully are stored up as acquisitions and have become and continue to become freely available.[49]

This only adds more confusion to our understanding of logic. How can logic arise from the subject without being subjective? We can see that for Frege and other logicians, there is a move from the subjective to the objective, whereas for Husserl, the objective is to be found in the subjective. That this puts him at odds with his contemporary logicians is clearly stated in *Experience and Judgement,* where Husserl says that if the logicians really aim at logic, they shouldn't simply play with the rules of the game, but should "direct [themselves] towards the laws of formation of judgement"; otherwise, they merely comprise "the merely negative conditions of the possibility of truth."[50] This critique resonates with Husserl's critique of Galilean geometry, which indicates the beginning of the crisis of European sciences. Geometry for Husserl originated from the measurement of land and rivers in ancient times. Measurements imply an intuitive experience of the world. Modern geometry becomes practical geometry in the sense that all knowledge is subsumed under calculation and abstraction without experience. In 1898, Hilbert gave a lecture in Göttingen titled "Elements of Euclidean Geometry"; this was never intended to be a course on geometry, however, and what Hilbert wanted to do was show that "it must be shown by pure logic that the theorems follow from the axioms without the corrupting influence of what we can 'see' by looking at a diagram."[51] The reduction of experience to abstract knowledge implies progress toward a naive realism. It is true that pupils in school are told that the origin of geometry was measurement, but this mere historical knowledge doesn't reopen the realm of its originary experience. This reduction is not only the reduction of primitive knowledge to a highly abstracted realm but also the modification of the structure of meanings, which cannot alone restore the development of scientific knowledge. Husserl's thesis "The Origin of Geometry" sets itself the task of restoring such a meaning. Now that the doubt about logic is the same as the crisis of the spirit of European sciences, the opposition is between one kind of truth that is guaranteed by axioms and another made possible through experience.

For logicians, the predication of the object has to guarantee two criteria: one is the truth value of the propositions (truth in itself), the other that the truth has to be independent of experience (truth for itself). Husserl's phenomenological approach is critical of this dogmatism. To transcend the limits set by logic, Husserl has to overcome these two criteria while preserving the idea of truth. Understanding Husserl's method is important for speculating on the relation between computation and experience. For Husserl, the intimacy between the human and technics is maintained by unfolding experience, which also conditions a true foundation for science. The immediate response will be, isn't computation itself experiential? The users interact with software, video games, and so on, which elicit experiences and excitement. We are not denying this fact. When Husserl was lamenting that arithmetical thinking becomes "free, systematic, a priori" and "completely liberated from all intuited actuality, about numbers, numerical relations, numerical laws,"[52] he didn't mean that arithmeticians calculate mechanically, because they still have to think creatively to solve problems and make great discoveries, but rather that "they have acquired, unnoticed, a displaced meaning."[53]

Knowledge systems, in this case geometry or logic, become more and more rule based. In the context of a technical system, it is rather objects—technical objects, then digital objects—that become rule imposing. Certain systems tend to create short circuits of meanings that render engagements with technical objects superficial (e.g., simply pressing a button to start and stop an engine, repeating the same gestures on an assembly line). To restore the foundation of knowledge, knowledge cannot be conceived in purely abstract forms, such as represented by detached symbols, but must be founded in humans' "kinestheses," that is, the movements of the living body. It is the same for our case: digital objects don't obliterate experience, but they do modify meanings, and the question is not really what is modified and what is not but rather, will we be able to create a new condition of involvement to reactivate abstract knowledge? If Husserl's task is to unfold concrete and abstract knowledge through his phenomenological approach, it will also be useful for our investigation into digital objects and the conceptualization of a transductive logic.

Intentional Act and Transcendental Logic

How can we find a ground for eidetic knowledge while remaining transcendental? Husserl retreats to Descartes's formulation of the ego in his *Cartesian Meditations.* For Descartes, the ego serves as the foundation of certitude and begins from the formulation "I think therefore I am." This corresponds to what Husserl calls a *phenomenological epoché,* a bracketing of the world by suspending all presuppositions and idealities. The *epoché* distances the human from his naive attitude to the world and places him in a position that enables him to reconstitute the world and hence truth. Now, what the ego is experiencing are not the "real objects" with which we deal in the world but rather a flux of consciousness, which has to be reified or objectified through the intentional acts of the ego, that is, *cogitationes.* The flux of consciousness is thus the "honest description of the unadulterated data of experience" disclosed as the *cogito.*[54] In Descartes, Husserl also identifies his concept of intentionality as the act of the ego:

> Intentionality is either itself an awareness of evidence—a characteristic of the cogitatum itself—or it is applied and directed (essentially and in the manner of a horizon) to "authentic givenness" *(Selbstgebung).*[55]

The task of Husserl is exactly to develop a theory that is able to unveil the structure of intentionality and the possibility of an apodictic science. For the purpose of our investigation, we would say that such a theory discloses the meaning structure of a predicative judgment. For Husserl, there are two levels of objectifying operations, the first of which is receptive experience, the second being predicative spontaneity.[56] Receptive experience is the experience by which the objects give themselves directly to us. The objects give themselves in our consciousness as hyletic and morphic data and constitute our pre-predicative experience. The expression of the object and the categorial intuition of the ego upon perceiving it result in a categorial form. In the discussion of context in Part II, we used the example of a man going home and seeing something in the corner of his room that looks like a snake. The setting given to the man constitutes for him a situation of suspicion that is an example of the pre-predicative experience. Now he will have to scrutinize the object to determine whether it is a rope or a snake, but subsequently he finds that it is only a rope. We should note that there is a process of negation here, as the anticipation of a snake is negated by the investigations the man carries out. Here we find that negation is not simply a singular predicative judgment but rather takes its original form in the pre-predicative sphere of receptive experience. This means that meaning is fulfilled in the intentional act; hence a judgment for Husserl is fundamentally a fulfilment of meaning. A question arises immediately: how is this related to a proposition (e.g., "A is not B")? Husserl correlates the judgment of truth (the proposition) with the judgment of existence (the meaning). For a computer, the judgment of a proposition is nothing but the technicization of knowledge, whereas for a human being, the logical operation has to be based on experience itself. This is precisely the motivation of transcendental phenomenology.

Husserl's phenomenological method has no place in a machine, and that is also why the formal ontologists find only the arithmetician Husserl important and not the phenomenologist Husserl. In any sense, phenomenology is a method that suspends the natural attitude and unfolds the structure of meaning in everyday activities. Addressing the correlation between the proposition and the experience is for Husserl the true investigation of knowledge. We may then want to ask, what is the difference between transcendental philosophy and psychologism or even descriptive psychology? Didn't Husserl himself propose a cognitive process as the foundation of the laws of logic? In *Ideas Pertaining to a Pure Phenomenology,* Husserl admitted the difficulty of resolving the relation between phenomenology and psychology:

> In fact, it is (if I may be allowed a judgement from my own experience) a long and thorny way starting from purely logical insights, from insights pertaining to the theory of signification, from ontological and noetical insights, likewise from the customary normative and psychological theory of knowledge, to arrive at seizing upon, in a genuine sense, the immanent-psychological and then phenomenological data, and finally to arrive at all at the concatenations of essence which make the transcendental relations intelligible *a priori.*[57]

We see from this confession that Husserl was struggling from the time of his psychological approach in the *Philosophy of Arithmetic,* to the psychological theory of knowledge in *Cartesian Meditations,* and finally to a truly phenomenological method in his late works. Husserl is sympathetic to psychology.[58] It is not surprising that phenomenology has its roots in psychology, though it has surpassed psychology to bring forth pure logic. The difference between them is also an important question for us, because our concern is to show not only how it is possible to arrive at the apodictic understanding of objects but also the different levels of meaning structures. Psychology has been widely employed in interface and system design by investigating the psychical activity of users. But we don't really have a phenomenological approach to computation, unless we take formal ontology further. Husserl's critique of psychology is rather complicated, hence I simplify to highlight two main points. First, psychology is inherent to the Cartesian dualism, and this stops it from becoming the foundation of science. Second, psychology as the science of internal experience has an affinity with phenomenological–psychological deduction (the first deduction), but it never reaches the phenomenological–transcendental deduction (second deduction), and it is only in the second deduction that philosophers are able to arrive at a transcendental ego.

To clarify the first point, we have to develop Husserl's critique of Descartes. The question is, why was Descartes not able to develop a true transcendental philosophy after discovering the certitude of the ego and descriptive psychology? Husserl believes that at the same time Descartes made a serious mistake, because he also excluded the body as *res extensa*. The ego is now pure soul, having gotten rid of the body. Descartes believed that this soul has a substrate such as the physical body. The problem is that, on this basis, Descartes was not able to carry the *epoché* to its most radical form and regressed back to the pure soul. Underlying the Cartesian regression is a double movement toward objectivity following on from Galileon geometricization. First, Descartes wants to infer an objective outer world from the inner soul; second, he wants to develop an objective science of the soul, which is to say, a psychology. In Husserl's own words, the egological immanence is substituted by psychological immanence. The pure soul is the residuum of the abstraction of the physical body, but without submitting the self to that of a phenomenon:

> The whole gain, the great discovery of this ego, loses its values through an absurd misconstitution: a pure soul has no meaning at all in the epoché, unless it is a "soul" in "bracket," i.e., as mere "phenomenon" no less than the living body.[59]

We should pay special attention to two terms here: *phenomenon* and *living body*. Descartes put himself in a paradoxical situation, because his approach necessitated that the soul infer the world. He could not solve this problem without sheltering in the concept of God, that is to say, God's benevolence acts as the bridge between the ego and the world. This, to Husserl, is absurd. The *epoché* is supposed to reduce the world, including the self, to a phenomenon and allow the phenomenon to be self-evidential; this is also what is indicated in the phrase "back to the things themselves." Through the bracketing, the ego will be able to see the phenomenon without presuppositions. Moreover, a living body *(Leib)* is not a physical body *(Körper)*. The physical body is purely physiological, but the living body is the only body given to me in reception and that "acquires the ontic validity of the physical body."[60] The living body is Husserl's key for overcoming the dualism, and indeed, the ego can only know the world through the living body, a concept of the life-world *(Lebenswelt)* to which we will return.

Sinn, Bedeutung, and Meaning Horizons

The preceding sections attempted to show that formal logical thinking concerning the Web is inadequate by looking into the *formal* relation between logic and object. The discussion of Husserl raised another theoretical understanding of the relation between logic and object. Frege's logic was referred to as extensional logic and Husserl's as intentional logic. For Frege, truth doesn't depend on the sense *(Sinn)* but on the reference *(Bedeutung)*. Philosophers try to identify Frege's *Sinn* with Husserl's meaning and his *Bedeutung* with Husserl's objects.[61] It is not our intention to engage in a historical study of the debate here, but we assert that such an identification ignores the fact that meaning in Husserl's sense is continuous, motivated, and based on experience, while meaning for Frege is always discrete and abstract. In other words, meaning for Husserl is a capturing process, whereas for Frege it is an axiom: Husserl's meaning as an evolving manifold may be corrected, whereas an axiom cannot be corrected (because if it can be determined to be wrong, it cannot be considered an axiom). For Husserl, a round square bears meaning, but for Frege, it is absurd. In volume 2 of *Logical Investigations,* Husserl directly spoke against the Fregean distinction:

> "Meaning" *[Bedeutung]* is further used by us as synonymous with "sense" *[Sinn]*. It is agreeable to have parallel, interchangeable terms in the case of this concept, particularly since the sense *[Sinn]* of the term "meaning" *[Bedeutung]* is itself to be investigated. A further consideration is our ingrained tendency to use the two words as synonymous, a circumstance which makes it seem rather a dubious step if their meanings are differentiated, and if (as G. Frege has proposed) we use one for meaning in our sense, and the other for objects expressed *[für die ausgedrückten Gegenstände]*. To this we may add that both terms are exposed to the same equivocations *[Äquivokationen],* which we distinguished above in connection

> with the term "expression" *[bei der Rede vom Ausgedrücktsein],* and to many more besides, and that this is so in both scientific and in ordinary speech.[62]

Husserl was aware of the distinction between the object and meaning in Frege, but he decided to ignore it. His refusal to accept Frege's criticism is based on the view that Frege is not able to recognize that objectivity is not the object out there but rather the meaning structure that correlates to the object. Objectivity is thus not the object as a mere thing out there but the object's relation to the life-world through my living body *(Leib)* and phenomenological reflection.[63] So we need another idea of objectivity, an objectivity that is eidetic but nevertheless subjective:

> each of us has his own experiential representations but with the normal certainty that everyone present experiences the same things and in the possible course of his experiences can come to know the same things through similar properties.[64]

Is this naive? For many logicians, the late Husserlian theory of logic went astray. For example, in the preceding quotation, the phrase "normal certainty" holds no validity in formal logic. There is either certainty or non-certainty but not "in most cases certain." But Husserl also rendered absolute objectivity into an ideality situated within the subject's life-world. This ideality should aim to be unconditionally valid for all subjects, "beginning with that on which normal Europeans, normal Hindus, Chinese, etc, agree in spite of all relativity-beginning."[65] Now Husserl finds the ideality neither in the object nor in individual mediation but in human communication. Communication or intersubjective understanding constitutes objectivity by acting as the indicator or timer of the transcendental deduction:

> idealizing thinking conquers the infinity of the experiential world as a world knowledge to be attained *idealiter* through the thought and conceivably through continuation and infinite perfection of external experience, knowledge based on a conceivable renewal "again and again" of the enrichment of experience.[66]

What, then, is this idealizing if it is not internalized by communication and agreement? The simplest way to achieve this ideality is to develop a standard ontology for everything through writing. If this ontology is used as the basis for understanding, then objectivity is already established. This is the case not only for geometrical objects, for example, rectangles, but also for cultural objects. In *Experience and Judgement,* Husserl speaks of free and bounded ideality. A rectangle is a free ideality that remains the same everywhere, but a bounded ideality like a cultural object is bound to a spatiotemporal setting. The ideality of geometry is not created through communication but is rather preserved through it. For Husserl, the questions are, first, how this ideality is derived (whereby no matter how many times it is repeated, it produces the same objective sense) and, second, how these idealities can be reused without leading to an automation that eliminates experience. Hence it is clear here that Husserl gives priority to cognition over communication.

Object and Imagination

It is worth distinguishing our conceptualization of the technical system here from that of Niklas Luhmann's systems theory, so as to distinguish from a technocratic system of communication. Luhmann's systems theory takes a similar approach to Husserlian phenomenology. For his social system, the most important concept is meaning, and when he talks about communication, he refers specifically to Husserl's meaning and cognition, though still maintaining a distinction between the meaning of cognition and the meaning of communication.[67] Luhmann takes Husserl's analysis of intentionality into his analysis of communication, translating the phenomenological reduction into the "reduction of complexity."[68] Then he goes beyond intersubjectivity in developing his systems theory. In our discussion of the digital as a technical system that co-constitutes human and computing tools, digital objects act *both* as *objects of cognition* and as *objects of communication* and allow us a new interpretation of objectivity and possible worlds. For Husserl, the meaning of communication is indispensable from the meaning of cognition. We go further into the question of cognition in chapter 6.

In his *Crisis of European Sciences* and essays such as "The Origin of Geometry," Husserl further proposes that communication serves cognition. For to preserve the eidetic truth of geometry, we have to keep communicating its original meaning from generation to generation. So the object of recognition is not ahistorical but belongs to the life-world. But how can we know the origin of geometry, and in what sense can we experience its origin if we are only speculating about its origin from historical fragments? To consider a mathematical theory, for example, the Turing machine, as a collection of axioms arranged through an algorithm, which ensures the validity of each operation (e.g., writing in the squares on the paper tape), it always goes from a basic axiom to a wider range of axioms. Isn't this basic axiom the origin? But Husserl's origin doesn't mean anything like this, because origin for him must be experiential and intuitive:

> original self-evidence must not be confused with the self-evidence of "axioms"; for "axioms" are in principle already the results of original meaning-construction and always have this behind them.[69]

The axiom already has a well-established meaning structure, and it can be adopted dogmatically without being experienced. Now the original meaning remains a question for scientific investigation. How can we grasp the origin of geometry when we have already been told from time to time that it originated from land and river measurements? Husserl's solution is to look at the present, or at what he calls the "historically primary in itself."[70] The present is also the life-world. Husserl proposes his phenomenological method as holding the possibility of arriving at a historical certainty:

> Through what method do we obtain a universal and also fixed *a priori* of the historical world which is always originally genuine? Whenever we consider it, we find ourselves with the self-evident capacity to reflect—to turn to the horizon and to penetrate it in an expository way. But we also have, and know that we have, *the capacity of complete freedom to transform, in thought and phantasy, our human historical existence and what is there exposed as its life-world.* And precisely in this activity of free variation, and in running through the conceivable possibilities for the life-world, there arises, with apodictic self-evidence, an essentially general set of elements going through all the variants; and of this we can convince ourselves with truly apodictic certainty.[71]

The origin is imagined from the fragments of history that are present to it! Then isn't this origin in itself arbitrary, because it exists only in fantasy and imagination? How can the apodictic certainty be mediated? The only way for Husserl is through the phenomenological reduction. Only through the *epoché* is one able to trace the complexity of the *noesis–noema* correlation and to arrive at an apodictic understanding. This doesn't involve a simplification but a clarification.[72] We have to say that Husserl never makes it clear how this can be done exactly. Indeed, he sometimes ignores that which is contradictory in his thought, for example, the fact that horizon is always associated with something else in the life-world, so that the identity of an object cannot be completed at certain points but rather its relations extend into infinity.

The constitution of objects is no longer a form-imposition but rather unified relations from the subject of consciousness. This brings us back to the comparison of Husserl and Simondon that Deleuze has made and that we mentioned earlier, that is to say, protogeometry and modulation by intensity. To be is to be bounded by intensity.[73] There remains a question to be resolved in the following sections, namely, how to mediate between the act of ideation bounded by the meaning horizon and the act of idealization through exteriorization. At this moment, we have arrived at, after a long exposition of the question of logic and object in analytic philosophy and in phenomenology, developing certain compatibilities between Husserl and Kripke and Putnam. One may ask, isn't this the opposite to what we have discussed previously concerning relations and interobjectivity as opposed to intersubjectivity? Such would be the case if we were to attribute the concept of object merely to a subject, that is to say, to see the object as constituted purely by *noema* corresponding to *noesis.* For example, when we look at a stone and turn it into an object of consciousness, we may have different meaning horizons for the object before us. These horizons may converge or overlap in certain ways that give us a common identity of the stone. This common identity is achieved through different levels of categorization, as Simondon explained in *Imagination et invention* in terms of biological, mental, and symbolic registers. Conversely, we can also consider these different orders as possible worlds (or realities): the perception of a stone as such allows us to say that we have seen a stone as such, so an identity is formed across the first order of the possible worlds. Yet when it comes to symbols and images, a sociolinguistic division of labor is required such that an identity may not be given without communication: it is both intersubjective and interobjective.

A digital image wrapped in metadata allows both human and machine to recognize that it is an image of a certain thing. This recognition is limited to certain lower orders of magnitude, for example, biological for humans and logical for machines. Both inductive logic and deductive logic operate on levels of consistency to preserve the truth condition of their systems. The abductive logic developed by Charles Sanders Peirce (1839–1914) comes from pragmatic consideration: it is a guess that tries to give us the best explanation from observations. It often gives us sufficient causes instead of necessary causes, like Kripke's possible worlds explanation. In contrast, a transductive logic is less about explanation and more about transformation. In this transformation, the coherence of different orders of magnitude is preserved, but the structure of the system has also changed. Transduction comes out of an energetic field, which Simondon calls the ground: "the ground is what conceals the dynamics; it is what makes the system of forms exist. The forms do not participate in forms, but in the ground, which is the system of all the forms . . . the ground is the system of virtuality, of potentials, of forces."[74] In our context, this ground, it seems to me, resonates with Husserl's life-world, and information or intensity with meaning.

Life-World and Crystallization of Categorial Forms

The life-world, as Husserl puts it is "the forgotten meaning foundation of natural science."[75] The life-world is opposite to the technicization *(Technisierung)* and formalization of knowledge. The life-world is the ground of all forms. For example, let's consider an unicorn. How can a unicorn, a nonexistent object, bear any meaning at all without a life-world? The internal horizon cannot be actualized in the imaginary process of the unicorn but has to be directed to the external horizon, for example, the memory of a unicorn, the myth concerning the unicorn. The motivation process of the horizon is not linear; it anticipates, negates, remembers, and so on. This exposition hopes to bring us back to a reflection on objectivity and meaning. The critique of logic in the thought of philosophers such as Kripke and Putnam amounts to an effort to extend a logical system into a broader and flexible model that captures meanings, instead of being restricted to the synonymous relation between names and references. We should then radicalize such an imperative in the development of the logical language of the Web. If printing is a technics that brings objects into circulation and communicates the original experience of geometry to the subsequent generations, then the new writing that we can find in digital objects allows us to reconstitute a new hermeneutics with finer divisions; history is turned into records, taking on, as we have discussed, a topological temporality—though the term *topological* is no longer a metaphor but indicates something mathematical and calculable. This shift in hermeneutic model reduces the implicit mediations that traverse time and space and that bring humans together explicitly.

This explicitness brings objects and human beings closer; it also brings meditative meanings to lower levels, which allows automation to be dominant. For Simondon, automation is the lowest level of perfection of machines (we understand here that by *automation,* he refers to the simple repetitive operation of machines); in contrast, automation must be problematized and the human must be reintegrated into the technical system. It seems to me that Simondon's seeking to restore human beings as technical individuals (in which the human is able to create an associated milieu of its own) is similar to Husserl's agenda to retrieve experience from abstract symbols and rules. Husserl's phenomenological method has been little used in the construction of web ontologies, because most of the ontologies we use today are merely inductions from the empirical experiences of engineers; however, Husserl's phenomenology seems to me valuable in its problematization of pairs such as logic–automation and ontologies–meaning horizons. The Husserlian method remains a useful motif for us to think about digital objects.

One polemic example that is in line with this Husserlian–Simondonian critique is collaborative annotation or, more in its most primitive form, tagging. Tagging has often been considered opposed to ontologies, especially in provocations by some popular writers such as Clay Shirky.[76] We will have to distinguish ourselves from Shirky's position because it is too easy, and ultimately unhelpful, to claim that ontology is overrated. For in the end, ontologies are necessary, ontologies are productive and can strategically serve as "shortcuts." First, tagging is an organization of relations that destabilizes the conception of objectivity and monolithic meanings. Tags are expressions of different individuals, forms coming out of the lifeworld of each individual. Second, while tagging may be the most *intuitive* form of arriving at objectivity, it is still one that is *immature*; furthermore, we can think of other models of tagging (with a variety of predicates, such as *is, has, is_part_of*), such as those used in formal ontology, as well as other types of contributive ways of understanding objects, such as through the invention of new vocabularies, as in Heidegger. Tagging alone is not sufficient, and indeed it needs many other constraints, for example, to limit the number of tags to ensure that they are well chosen.[77] But at its minimum, tagging serves as an example of how different possible worlds may be brought together. Here we can refer to the possible worlds and meaning horizons of different actors. If we consider the name–reference relationship as an effect of a family of relations and descriptions, then tagging on a digital object brings these different description systems together, including those that are mutually contradictory: ugly and beautiful can come together—this would probably be a better example of Kripke's possible worlds, because there is a reality where an object is at the same time beautiful and ugly. On the side of the individual users, tagging puts the users in the particular situation of being able to make judgments, instead of limiting them to reading by pressing a few simple buttons. It opens a new process of collective ideation toward idealization in both objective and material senses. Now to judge is not to give a predicate to the object, but rather it involves a retrieval of the life-world, a reactivation of the experience of others and their intuition toward objects. These intentional retrievals are then turned into URIs or other forms of material relations and cluster with other relations.

The digital object with user-generated tags becomes a special cultural object consisting of different intentionalities represented as traces of interactions and retrievals; it doesn't just present itself as an object that belongs to a specific culture but also as the constitution of the *We* against the solipsistic contemplation of the world. I am tempted to think of the initiative of tagging as a possibility of developing a Husserlian critique of the Web—a standardization of categories that traverses all cultures through the Web—as well as to locate in it the possibility of further developing a transductive logic corresponding to Simondon's thinking. Tagging or other contributive forms of annotation should be considered methodologies that add a new term beyond implicit and explicit, just as transduction serves as a third term in addition to induction and deduction. We may call this third term "complicity." The word *complicit,* according to the *Oxford English Dictionary,* comes from the French word *complicité,* which has two meanings. The first is "mutual understanding," for example, as when two people look at each other and laugh at the same time without further communication; the second meaning is "participation in delinquency." Complicit is neither explicit, because the compound descriptions cannot be reduced to truth statements, nor implicit, because it is already stated as such; at the same time, it problematizes and destabilizes the present status as delinquencies. I understand this as *tension* in Simondon's concept of individuation and Husserl's doubt–explication pair in the formation of meaning horizons. The stabilization of the meaning horizon could be perceived as the crystallization of tags through secondary treatment, for example, the creation of TagCloud, which is a selection tool showing which tags are used more often and hence are possibly more mature than others.

The phenomenological method has reactivated the observer's experience of objects by suspending his or her usual perceptions and makes science concrete rather than merely abstract. Husserl's critique in "The Origin of Geometry," as we have seen, is precisely intended to achieve this aim, to undo the naivety of the natural attitude in our everyday life. To reawaken the experience is to restore the life-world back to its technicization. Phenomenological methods have to be called upon again and again to negate this attitude. If tagging is a process of reduction, it may present us with the possibility of bringing forward a long circuit of experience. The experience awakened must be something against the automation of knowledge, and indeed, because we are now in a technical system, we can always use the "adding up" to create new possibilities, for example, through a different algorithm and data structure design. But these questions have to be understood not as something addressed merely for the sake of efficiency and real time. We are not against real time in terms of the response of the computer but rather against the mode of interaction that reduces users to passive subjects who bypass expression to go straight to indications.

From Interobjectivity to Intersubjectivity and Back

As we have seen, for Husserl, cultural objects presuppose the a priori structure of intersubjectivity, which is revealed in objects as traces of the living body. Husserl turned to Leibniz's monadology for his theory of intersubjectivity in which egos are like monads: they have their closed worlds, but they can sense others without material connections. We may ask, if an ego only has one world, how many possible worlds does an object have? Heidegger said that a stone doesn't have a world. We disagreed with this in that a stone's world is relational just as much as a human being's, for without the stone, the ants wouldn't be able to find a good location for their dwellings, just as an old lady wouldn't be able to find a place to sit down after the pilgrimage to a temple. If we read it from the perspective of the Husserlian distinction, passivity and activity belong to human beings *only,* and so objects like stones are signs that only present them with a passive synthesis: they are things to sit down on, to be thrown away, to be kicked, or to remind us of something or somebody. When Schutz followed Husserl's intersubjectivity and compared a stone and a person, he said, "If I see a stone within my reach, I simply see it, and that is the end of the matter. If I see an Other person in my reach, I necessarily discover that, inversely, I am also in his reach: he sees me."[78] With a natural object, the passivity of synthesis posits the object within the subject's isolated cognition: one tree out of thousands of trees in the Black Forest, one stone out of thousands on the beach. But another person displaces the "I" out of its solipsism to recognize the "we." Here we will have to clarify an ambiguous question: what is the position of the "we" in the phenomenological reduction? The phenomenological reduction is not a separation from the world but is the method we can perform to scrutinize the granularity of noetic acts. The person who performs the noetic act is still in the world with others, only in the transcendental reduction, these relations come into clarity. Tagging or contributive annotation, which we understand as a constant reduction, reveals to us the complexity of noetic acts and noematic contents in their actualization. Husserl applies this understanding to all cultural objects:

> This applies furthermore also to all human products in visible reality. As products of the animated Body, they are animated just as any thingly process produced, stimulated, or elicited by human agency: a stroke that is aimed, a stick wielded, a book written, etc., take on the spirituality of the Body. The movement of a machine has its spirituality just as the machine itself has. Each work, each product, each action expresses an activity and is characterized as work, as act: one sees how the cigar is rolled, one discovers therein the expression of a manipulation and, on the other hand, the "visible" aim. The handwriting, each stroke in it, its "ductus," bears the stamp of the objective spirit. In short, products and works are again psycho-physical unities; they have their physical and their spiritual aspects, they are physical things that are "animated."[79]

Husserl was here trying to unfold the meaning structure of cultural objects. Cultural objects always embed a meaning structure that doesn't exhaust itself in the *eidos.* Each work presents us with a process of its making and expresses something more associative than what is directly given. Husserl calls the appearance and the expression beyond the appearance "psycho-physical unities." Cultural objects have their world because it is not a passive spontaneity, but a unity of retentions, that provides an infinite source for the horizon. In tagging, when we say that object A reminds us of something, this is an association based on its appearance. Now we want to ask, do digital objects have a world? There is not just one world but many possible worlds. These worlds are not isolated like the monads that contain other worlds internally and implicitly but are rather open to one other and unified in digital objects through interobjective relations. The digital object opens up worlds, unifies them, and discloses to the users of the other possible worlds that objects are not passive syntheses but refer you to somewhere else, out of anticipation; this is usually called serendipity.

The possible worlds of the object disclose to us different meaning structures, that is, Others. Intersubjectivity has taken shape through the materialization and (materialized) organization of interobjectivity. The intensification of intersubjectivity can be effected through creating new interobjective relations in the technical system. The formation of interobjectivity, conversely, conditions the "We," which is itself not possible without experience, that is, without experiencing each other. If our hypothesis is reasonable, the way we interact with objects and enter into communication with them constitutes the "we" in the digital milieu. There is a passing over from the meaning of the cognitive to the meaning of the "we." This question has never been asked in formal logic, because it only addresses part of the system of interobjective relations. In the later stage of his life, Husserl revised his psychological tendency. In his first book on *Arithmetic,* he was comfortable about including psychology as the first step toward knowledge. The psychical entities revealed by the object demand another process of phenomenological reduction to appropriate the psychical as something rational, which we see now is a form of writing presenting itself as a metastable status of meaning horizons. Contributive annotation as a new form of logical writing further intensifies the "we." The technology of the "we" is an indispensable part of the objectivity founded on the subjective and the long circuit that reawakens our experience of the objects. Indeed, Husserl was right to say that "every spontaneity sinks down into passivity."[80] Like geometry, experience can dissolve materialization into signs, writings, and technical objects; the origin from then on remains invisible and is slowly replaced by a system of signs such as formal logic. Then, as we have seen, the reconstruction of the origin of geometry has to be based on the imagination of the present through the reactivation of technics of communication. That is to say, it has to change the relations sedimented in the technical system.

The comparison here between the Fregean tradition and the Husserlian phenomenological approach to logic aims to illustrate the nature of digital objects in their logical foundation, which is also the mathematical foundation of computation. It also wants to expose the limits of its understanding of objects by reintroducing phenomenology and, ultimately, to reconcile Simondon and Husserl. Engineers tend to accept this foundation of logic, because everything is already established: a well-defined system is already in front of us. But a hundred years ago, there were still doubts and suspicions. Today Husserl's challenge has become totally unheard in the study of computer science (except for parts of Husserl's *Logical Investigations*). We should be aware that the semantic web, including its architecture and the standards that it enforces, is only one way to organize digital objects: there are other organizations that we can imagine even within the technical system that we are in. But this also shows *how far standardization is from the reach of ordinary users or researchers who could have provided new perspectives.* This chapter has contrasted extensional logic and intentional logic and showed how such an historical account can be beneficially used to reflect on convergence and the internal transformation of the technical system. It has ended with suggesting that contributive annotation may be an example of the realization of what Husserl would call meaning horizons—an organization of relations (other than by formal logic) that is both collective and individual. It is also a process of collective deduction of relations, in which we can observe a transductive effect on both the technical system and the users. Tagging could probably have been implemented without the guidance of Husserl, but what our hindsight shows is that philosophy can push this polemic in a more rigorous way, to modify an intersubjective system as suggested by Simondon. Seeking for a Web that goes beyond the Web of automation is a question of searching for different logics able to give us a new form of perfection and organization of digital objects.

· CHAPTER 6 ·

Logic and Time

IN CHAPTER 5, we approached the question of convergence from the starting point of Husserl's intentional logic and formal logic (considered as two orders) in our search for a transductive logic. In this chapter, I want to move from the digital object to its milieu by showing that digital objects partially constitute what I call *tertiary protention.* Considering tertiary protention leads us into an inquiry into another order of experience that is different from the experience of the meaning horizon that we discussed in chapter 5 but that is fundamentally temporal and metaphysical. The aim of this chapter is to suggest that we should move from the notion of system to the notion of the associated milieu proposed by Simondon as a response to the rampant advance of industrialization. I take the word *protention* from Husserl, for whom it means the anticipation of the next moment. Corresponding to the primary and secondary retention that we discussed before, there are also primary and secondary protentions: the primary protention being the anticipation of the immediate coming moment, for example, melody when listening to a song, and the secondary protention being anticipation or expectation based on past experience. Protention is hence also imagination, through which we recollect and recognize what we have experienced and project it into the future. By tertiary protention, I refer to the fact that in our everyday lives, technology becomes a significant function of the imagination. Let's look at a simple example: when people want to go to a restaurant, these days they are increasingly likely to search online first. We might also notice that Google is able to suggest which is the closest and most preferable restaurant for their needs according to its search and recommendation algorithm. We can make at least two primary observations based on this example: (1) tertiary protention tends to depend on tertiary retention, for example, the relations given by digital objects, those traces we have left, such as pictures, videos, or geolocations; and (2) orientation becomes more and more an algorithmic process that analyzes and produces relations to pave the way for the experience of the next now or the immediate future.

After the theory of Marshall McLuhan, André Leroi-Gourhan, and other thinkers of technics in the twentieth century, it is no longer a surprise to say that technologies are the extension of the body. This also resonates with the work of some cognitive scientists and analytic philosophers, such as Andy Clark and David Chalmers, who have proposed an understanding of the "extended mind."[1] The mind outside of the skull conditions the appearance and hence the experience of the phenomenon. Let's follow Clark and Chalmers's example of two protagonists, Otto and Inga, in their article on the extended mind. Otto suffers from Alzheimer's disease. He is not able to remember things, so he relies on his notebook, in which he stores his notes and which acts as his externalized memory. Inga is normal and has proper access to her memory. If Inga wants to go to the Museum of Modern Art, she recalls that it is on 53rd Street, whereas if Otto wants to go to there, he will have to access his notebook to find out this information. Now there is a relation between Otto and the notebook that is comparable to the relation between Inga and her mind. These extensions are spatial. It is probably only in the work of Bernard Stiegler that we see technics as time in the form of retentions. The body can extend following a technical lineage, but only through time can we retrieve the status of existence and put extension into question. This chapter is very much in debt to the works of Bernard Stiegler, especially his analysis of Kant's *Critique of Pure Reason* in the third volume of his *Technics and Time 3—Cinematic Time and the Question of Malaise.* I want to develop the implications of the hypothesis that imagination itself is no longer the imagination of the subject but rather shifts from subject to algorithms and digital objects. How about things that we cannot experience, or that we can call nonexperience, such as the execution of an algorithm that gives us the givenness of digital objects? On one hand, as we have already stated in the first chapter, discussions of lower-level realities, such as atoms, electrons, or logics, ignore the concreteness of phenomena, that is, the other factors that give rise to a perception of reality as such. On the other hand, we have also noted the ignorance of phenomenological inquiries, which bypass the lower-level reality and its relation to higher-level presentations. We cannot have an experience that an electron has just struck our skin, but we can imagine it; in like manner, we cannot experience the algorithm itself, but we can more or less imagine it within the limits of our cognitive capacity. What happens when such nonexperiences now concretely participate in our imagination?

We can see that, more so than the "natural environment," technology is engaging more and more in our thinking processes, not only in that our environment is full of gadgets but more importantly in terms of the logical capacities and operations of machines. With Edwin Hubble's hundred-inch Hooker telescope, humanity suddenly discovered that there is nothing more fearful than the infinite.[2] What people saw before their eyes were no longer simple objects like trees but the consequences of pre-pre-predicative experience: the mind reaches the world through the lens, without which there remain only trees in the garden and the walls that surround it. There is a distinction that we need to make here. Our engagement with technical systems is no longer the same as the encounter between *Dasein* and simple tools such as the telescope. Inside the system or an ensemble, decisions are systematically determined by algorithms instead of relying on the subjective selection of significations. The obstacle to thinking about protention and algorithm together lies in the general conception of an opposition between imagination (time) and mechanism (formal logic), which has to do with the foundations of metaphysics. We still tend to believe in the human as the only subject that imagines; though machines produce a range of choices, the ultimate decision belongs to humans. In the following sections, we will see why time and logic compete to be the ground of metaphysics by looking at the debate between the neo-Kantians and Heidegger. Heidegger wanted to retrieve the transcendental imagination of Kant instead of logic as the foundation of metaphysics. If transcendental imagination constitutes the foundation of metaphysics, to what extent can we also understand the tertiary protention in terms of a metaphysical question? And to what extent does this allow us to investigate the existence of digital objects? With our general method, we will try to understand time and logic as two orders of magnitude and see how to push forward the idea of tertiary protention by resolving (or jumping across) this division.

The First *Kehre* of Heidegger

We propose to consider three theories of experience concerning logic taken from Frege, Husserl, and Heidegger. The first two philosophers are logicians who present distinct theories of pure logic with a peculiar relation to psychologism, as we have seen in chapter 5. Heidegger is neither a logician nor a philosopher of logic; worse still, he has been accused of Continental irrationalism by some analytic philosophers.[3] However, Heidegger has a peculiar relation to logic, and it is obvious that the question of logic plays a constitutive role in his career. The turn *(Kehre)* in late Heidegger is well known as the turn toward history of Being. But there was probably an earlier turn, occurring around 1925–28,[4] marked by the publication of *Being and Time* in 1927, prior to which, in his earlier writings from 1910 onward, he was more concerned with studies on logic. Heidegger's dissertation on judgment and his *Habilitationsschrift* (1916) on Duns Scotus are both closely related to logic, and we can see how close his work is to neo-Kantianism and Husserlian phenomenology. In his reviews of recent developments in logic, he openly admired the work of Frege,[5] especially the two articles we discussed in the last chapter. In his dissertation, supervised by the neo-Kantian Heinrich Rickert, he clearly proposes the apodictic nature of logic, as John Caputo has summarized:

> The essence of the logical judgement is found in the self-identical meaning *(Sinn)* which is unaffected by the circumstances in which the judgement is made or by the state of mind of the one who judges. The mode of reality of meaning is the realm of "validity" *(Gelten, Geltensein),* which constitutes the essence of logical being. Validity belongs to neither the psychical physical nor metaphysical realm, but to an irreducible and uniquely "logical" sphere.[6]

Heidegger's position in the 1910s is still that of a disciple of Husserl, especially in relation to the *Logical Investigations,* which, according to Heidegger himself, he was amazed by but hardly understood.[7] This Husserlian stance is clear, because after insisting on the purity of the logical sphere, Heidegger also criticizes mathematical logic for the fact that it is "formal, and so is unable to deal with the living problems of judgmental meaning, its structure and cognitive significance."[8] His work on Duns Scotus[9] is basically a defense of Husserl's phenomenology by use of scholastic philosophy and a reinvention of the latter using phenomenological terminology.[10] This first turn in Heidegger is characterized by what he calls "hermeneutic logic" in *Being and Time* (which differs from his earlier interest in medieval philosophical logic), and it was brought forth by his inquiry into the question of Being in *Dasein*'s everydayness. The Heideggerian hermeneutic (the fore-structure) has to be clearly distinguished from the pre-predicative experience that Husserl elaborated in his 1939 *Experience and Judgement,* as we will clarify later. Heidegger's discussion raises a *radical* difference when compared with our studies of Frege and Husserl, but this radicality is no longer ever about *Gelten* and *Idealität*; rather, it is to do with a metaphysical question about human existence and technics. The ultimate question throughout Heidegger's career is, what is the meaning of Being (rather than τὸ τί ἐστι)? The breach that opens onto Heidegger's critique is the question concerning language. Language, or discourse, or human expression in general, is the way things are made intelligible: communicating and determining and making manifest. Heidegger understands expression as a complicated structure that has a fundamental role in experience, one that is even prior to sight:

> It is not so much that we see the objects and things but rather that we first talk about them. To put it more precisely: we do not say what we see, but rather the reverse, we see what *one says* about the matter.[11]

This is because Heidegger posits *logos* in ancient Greek not as language in its instrumental sense but rather as the process of disclosure.[12] At the beginning of *Being and Time,* Heidegger attempts to render the meaning of *logos* not as the rational but rather as talk, discourse *(Reden)*. For Heidegger, the translation of ζῶον λόγον ἔχον as "man is the rational animal" must be reinterpreted as meaning "man is the animal that has the 'potentiality for discourse.'"[13] *Logos* is now the way to the disclosure of Being. Hence *logos* as discourse (not language in the modern sense) has a greater affinity with the Being of beings than *logos* understood as reason, logic, and so on. Zῶον is directly related with life "from a primary experience of discoursing as a specific mode of *Dasein*'s being."[14] Now this primary experience of λόγον—λέγειν (to lay down, put in order)—is the decisive moment of disclosure, of truth.[15] The relation between truth and logos is complicated in this sense, and it is worth paying attention to what is meant by the statement "*Dasein* is always in truth and untruth." In apophantic logic, truth is based on identification and derivation, the making-present of the objects intended. Such a making-present doesn't apply in the case of absurdity, illusion, and so on, and this is why truth and untruth form the conditions on which an agreement is reached in terms of identification. In hermeneutic logic, however, Heidegger proposed, truth presupposes belongingness rather than identification; truth *(Aletheia)* is at the same time concealment and disclosure, and Heidegger uses the word *Beschicken,* which can be translated as "co-sent."[16] The double sense of concealment and disclosure also conditions the "truth" and "untruth" of *Dasein*'s being. In general, we can try to understand three types of truth in Heidegger, namely, the truth of Being *(ontologische Wahrheit),* ontic truth *(ontische Wahrheit),* and propositional truth *(Satzwahrheit).*[17] Ontic truth is related to propositional truth, especially in modern science and logic, because logic understood as the philosophy of science becomes the foundation of the judgment of ontic truth.

Heidegger and Wiener on Language and Time

Why, then, does this classification matter at all? Didn't the computational turn at the beginning of the twenty-first century already render Heidegger's critique impotent, as we came to understand in chapter 4 with regard to technological systems? We may observe that early cybernetics research, especially the work of Norbert Wiener, also presented language as marking the distinction between human beings and beasts. Wiener's understanding was grounded in a scientific conception of nature. Heidegger was definitely aware of this. Indeed, he cited Norbert Wiener at length in 1965:

> Norbert Wiener's definition of the human being is as follows: "Man [is] an information [device]."[18] Wiener goes on regarding the human being: "Nevertheless, one characteristic distinguishes man from other animals in a way which leaves no doubt: Man is animal that speaks. . . . It also will not do to say that man is an ensouled animal. For, unfortunately, the existence of the soul—whatever one may take it to be—is not accessible to scientific method of inquiry."
>
> As an animal who speaks, the human being must be represented in such a way that language can be explained scientifically as something computable, that is, as something that can be controlled.[19]

The consequence of this assessment, according to Heidegger, is that "if man is explained scientifically, then what distinguishes him from the animal—namely, language—must be represented so that it can be explained according to scientific principles."[20] Now Heidegger's question of language and logic must take a departure from this restriction to phenomena and descend instead to the basic question of human existence. In the works around the time of *Being and Time,* truth is not to be grasped but rather to be mediated through human experience, which doesn't share the abstraction *and* detachment from the world of modern logic but is characterized by a belonging to the world. This belongingness can only be found in *Dasein*'s being-in-the-world as the presupposition of the hermeneutic logic. And being-in-the-world is nothing but the question of care[21] *(Sorge),* or temporality. What Heidegger understands in this crisis of the grammatical and logical rendering of human discourse is precisely this question of temporality, the transcendence of *Dasein.* Traditional logic is characterized by the underlying "logico-grammatical parallelism" manifest in its categories, whereas Heidegger proposes that ancient Greek thought forms an exception to this general trend, as it "frees grammar from logic and [is able] to reconstruct linguistics on a more primordial ontological foundation."[22] One may be tempted to trace this back to the influence of Alexander von Humboldt's philosophy of language, which Françoise Dastur has suggested forms the framework for Heidegger's understanding of language. Humboldt explored the complexity of *Sprache* not as a means for the "exchange of mutual comprehension" but as "a real world that the spirit must necessarily place between it and objects through the internal work of its force." Humboldt sees speaking as a "spontaneity" *(Selbsttätigkeit)* that is "inexplicable in its being," the work of the spirit that springs from deep humanity.[23]

The critique reveals two attitudes that still remain in opposition, if not antagonism, today. The opposition between them could be also understood as the opposition between *extension as instrument* and *intention as temporality.* In order not to come to an immediate conclusion, we should go further and ask, on what ground does Heidegger make such a claim about and critique of logic? In modern philosophy, the split comes from the interpretation of Kant's transcendental analytic, and if we want to arrive at an analytical answer, then we cannot avoid going into an investigation of Kant. In *Kant and the Problem of Metaphysics,* Heidegger proposes that Kant's *Critique of Pure Reason* is an attempt to lay down the foundation *(Grundlegung)* of metaphysics and that his own task in *Being and Time* is to ask the fundamental question underlined by Kant's notion of *Metaphysica Generalis*:[24] the meaning of being. What is the foundation that

Kant laid down in the first *Critique* and that Heidegger could take as his point of departure? It is precisely the question of time, posed as the question of the transcendental imagination. Before we go into the details of Heidegger's analysis, we may look at a famous example Heidegger used to demonstrate the temporal experience of discourse, and the detemporalization in formal logic. Let's consider the statement "the roses are blossoming" versus the existential statement in formal logic: $\exists x{:}P(x)$, where x is Rose and P is the predicate Blossoming. When one says "the roses are blossoming," there is imagination in which the body moves toward the present, whereas when truth is only concerned with the reference and the sense carried by it, as expressed in the second statement, then the sense doesn't arouse the temporal experience of the present but only a reduction of the judgment's content.[25]

A question immediately arises: on what ground can one say that temporal experience constitutes the distinction between *logos* as discourse and formal logic? This question must be addressed by a metaphysical answer, which owes its foundation to Heidegger's hermeneutic method: the search for and critique of presuppositions. Before we go into further reflection on this, we must make clear the connections between three different notions of time here, which we can summarize as the time of transcendental imagination, the time of *Dasein*'s everyday experience, and historical time.

Kant's Shrinking Back and the Nature of Synthesis

Heidegger had to find his explanation of the temporal experience, not in the mystery of the affectiveness of language, but in an analytic theory that shelters the temporal-ecstatic experience. Heidegger finds in Kant's having "shrunk back"[26] *(zurückgewichen)* the problematic of the position of the Transcendental Imagination. In *Edition A,* imagination is regarded as a faculty that is not reducible to sensitivity or understanding but is the source of synthesis. In *Edition B,* Kant is frightened by the transcendental imagination, and he proposes instead that understanding alone assumes the role of origin for all syntheses and that the transcendental imagination is only one of the functions of it.[27] Kant's recoiling or shrinking back presents a possible inconsistency not only with *Edition A* but also with what it means to Heidegger: "in between (the two editions) pure reason as reason drew him increasingly under its spell."[28] The spell of the transcendental imagination becomes the foundation of understanding itself. Then what is the transcendental imagination in Heidegger's reading? It is the synthesis of time. The transcendental imagination is the faculty that brings the pure intuition of time into order:

> Transcendental power of imagination allows time as consequence of nows to spring forth, and as this letting-spring-forth it is therefore *original time.*[29]

Why is time so important to Kant? Isn't time only one of the pure intuitions, along with space, in Kant's transcendental aesthetics? The relation that exists between the pure intuition of time, the transcendental imagination, and transcendental schematism needs to be briefly discussed here. In *Critique of Pure Reason,* Kant assigns the priority to time rather than to space, because he recognizes that all representations act independently of their content and are "temporal in as much as they are all, external as much as internal, situated in the 'flux' of consciousness."[30] To simplify the argument, the pure look given by the pure intuition of time produces a pure image of the "now," and it is also in this sense that Kant can say that "the pure image . . . of all object[s] of sense in general, however [is] time."[31] Transcendental schematism functions by determining time through articulating "the unique pure possibility of having a certain look into a variety of pure images." That is to say, transcendental schematism is the "transcendental product of the power of transcendental imagination."[32] Now we can see that time is of fundamental importance in Kant's transcendental philosophy, because it is through the a priori operation of time that experience is made possible. By quoting Kant's view that time "apart from the subject is nothing," Heidegger suggests that "this indeed implies that in the subject, it is everything." Time constitutes the finitude of *Dasein* as well as the transcendence of its being. By the same token, Heidegger is able to assert that the "rootedness in time alone enables the transcendental power of imagination in general to be the root of transcendence."[33]

This reading of Kant also implies that the syntheses are fundamentally temporal. It is necessary here to recapture the three syntheses proposed by Kant to facilitate the discussion of a fourth synthesis that serves as the base for tertiary protention. In *Critique of Pure Reason,* Kant gave three different orders of synthesis. The first is *apprehension,* meaning the process by which data that come into the mind are passively stored as manifolds. Kant makes a difference between synthesis and synapsis; the former is active, the latter passive. Heidegger suggested that Kant should use the term *syndosis* rather than *synapsis,* because *synapsis* already implies synthesis. It is in the synthesis of the manifold that time is given; that is to say, through the first synthesis, the manifold is put into temporal sequences. The second synthesis is *recollection/reproduction* in imagination; it differs from the first synthesis in that now the image is formed through the *Einbildungskraft* (power of imagination). The third synthesis is the synthesis of *recognition* in relation to a concept, which must at the same time be the recognition of sameness and the recognition of the concept's unity.[34] Heidegger uses three German words, *Abbildung* (likeness), *Nachbildung* (reproduction), and *Vorbildung* (pre-figuration), to characterize these three syntheses.[35] At first glance, it is very clear that these syntheses have the role of putting what is perceived in relation to time.

Apprehension already discloses the being-with, and recollection discloses the already-in, while recognition also means projection into the future, because recognition is already ahead of the past and the present. In the discussion of the past, Heidegger uses two German words, *Gewesenheit* and *Vergangenheit*: the latter means the past as characterized by works of historiography, whereas the former can be translated as "having been," as something that is past but projects into the future, its continuity being preserved in *Dasein*'s being-in-the-world. Kant posited recognition as the third synthesis, but for Heidegger, it is the first, and by reversing the order of the syntheses, Heidegger identifies the transcendental imagination with his understanding of *Vorstruktur* (understanding, fore-structure), because "the arguments for the necessity of *Abbildung,* or likeness, and *Nachbildung,* or reproduction, depend on the argument for *Vorbildung,* or prefiguration."[36] That is to say, Heidegger has constructed a circle for the three syntheses. Hence he writes in *Being and Time* that discourse, understanding, and interpretation are equimodal: understanding has *Vorstruktur,* in the form of *Vorhabe* (literally "fore-having," as when one "has it in mind to do something"), *Vorsicht* ("foresight," watching out for what is ahead), and *Vorgriff* ("pregrasping," commonly translated as "anticipation"), while interpretation follows the as-structure, that is, the structure of the "in-order-to" *(um . . . zu),* which, as we saw in chapter 3, becomes the signification of the instrumental totality. We also have to recognize that the as-structure (interpretation) cannot function without the *Vorstruktur*: without the latter, *Dasein* wouldn't know how to use a hammer. Thus there is discourse or verbal expression "only insofar as there is considering, and such a consideration of something as something possible only insofar as there is interpreting."[37] We will want to ask, what does this analysis imply, when syntheses are not considered to be separate operations but rather a cycle?

Temporal Synthesis and the Foundation of Metaphysics

The transcendental imagination as temporality distinguishes itself from schematization. Heidegger is able to use Kant to argue against the neo-Kantians' view that categorical logic cannot be the basic science of metaphysics[38] and that Kant's philosophy is not an epistemology but a ground-laying ontology. We have to bear in mind the shift from the critique of Kant that takes place from *Being and Time* in 1927 to the reinterpretation or defense of Kant in 1929. In *Being and Time,* Heidegger showed that the "I" for Kant is a "logical subject"—logical in the sense of being able to bind together, but not just a "concept obtained merely by way of logic." "I think" is to Kant "not something represented, but the formal structure of representing as such, and this formal structure alone makes it possible for anything to have been represented." The positive effects of Kant's understanding of the "I" are, first, that it resists the reduction of the subject to substance and, second, that it rejects the notion of the subject as an entity, determining it rather as the event "I think." Yet Heidegger went on to assert that Kant was not able to interpret the "I" ontologically; instead, he slipped back into the Cartesian mistake:

> he takes this "I" as subject again, and he does so in a sense which is ontologically inappropriate. . . . To define the "I" ontologically as "*subject*" means to regard it as something always present-at-hand. The-Being of the "I" is understood as the Reality of the *res cogitans.*[39]

In this reinterpretation, Heidegger argues that the "I think" is no longer a mere "logical subject"; it is "time" grounded in intuition, transcendental imagination, *and* understanding. This doesn't mean that we should reject Kant's logic in general but rather that logic cannot be taken as the ground; instead, the ground must be time qua transcendental imagination. That is, the rationalists' approach, which takes objects as bearers of attributes and treats the unity of subject and predicate as bearing the structure of propositions, has to be reassessed,[40] because the understanding of the object doesn't originate from thought but from time—the object is not merely determined by categories but rather relies heavily on the creative *(schöpferisch)* capacity of the intuition[41] and the productivity of the transcendental imagination:

> That traditional logic does not treat the pure power of imagination is indisputable. Whether logic does not need to treat it in general if it understands itself, however—this, at least, must remain open. That Kant takes the point of departure for his questioning time and again from logic is similarly undeniable.[42]

If time now becomes a problem of metaphysics, it makes sense to regard Heidegger's *Being and Time* as a new take on the Kantian project. Now we can understand why Heidegger criticizes formal logic as detemporalization. The issue is not that the understanding of the logical statement itself doesn't involve time, and indeed, if we regard transcendental philosophy as the condition of possibility of the empirical experience, then the transcendental imagination must serve the understanding of the logical statement. Rather, it is a question of how the understanding of language as logical statement, by enacting a reduction of the philosophy of language as a symbolic operation, already shields the question of temporality from its theory. And this exclusion of temporality will render the metaphysical knowledge based on it rootless. But then why does such an a priori of time matter at all? Because to Heidegger and his Kant, this understanding paves the way toward the answer to Kant's fourth question: what is human? If time is the primacy of human existence, then the *Dasein* in human beings must be approached through time; that is to say, the understanding of *logos* that characterizes the human being must be understood from temporality but not from logic. And language as the path to the truth of Being must share the same position as the transcendental imagination by rendering temporality as the primacy of *Dasein* intelligible. As Heidegger writes,

> it is not because time functions as "form of intuition" and was interpreted as such at the point of entry into the *Critique of Pure Reason,* but because the understanding of Being must be projected upon time from out of the ground of the finitude of the *Dasein* in

> man, that time, in essential unity with the transcendental power of imagination, attained the central metaphysical function in the *Critique of Pure Reason*.[43]

Traditional logic, or metaphysics, according to Heidegger, must be reassessed through this process of ignorance or, more precisely, of forgetting. The neo-Kantians' return to Kant for the ground of logic seems to ignore the difference between *Edition A* and *Edition B*. Heidegger asks, didn't Kant's modification in *Edition B* already give back mastery to the understanding but not to the transcendental imagination? This interpretation leads him to ask, "Is it not a consequence of this that with Hegel metaphysics became 'Logic' more radically than ever before?"[44] It is also no coincidence that we find in Husserl's 1936 *Crisis of European Sciences* a similar concern: the crisis of logic.[45] Heidegger shares Husserl's suffering, if not his solution: the purity of logic, as the foundation of science, eliminates genuine human experience.

The Fourth Synthesis after Kant

This grounding of logic as the foundation of metaphysics, which Heidegger criticized, anticipates a computational mind to come. When we look at the history of formal logic from Frege to Hilbert, then Gödel to Turing, we can easily see the connection between a computer and this specific reading of Kant. Heidegger's critique of logic leads to our reassessment of the foundations of the technical system and the tension between discursive relations and existential relations. Logical knowledge as *apodicticity* and a priori traverses human experience (whether psychological, imagination, phantasm, etc.) by creating a short circuit, and we can recall that Frege's project was to "replace a merely synthetic understanding of arithmetic with an analytical one" in order to "speed up the process."[46] An analogy is drawn by the historian of philosophy Julian Roberts between this and the replacement of the analog with the digital in modern technology, so that time-consuming processes based on mechanical rules can be replaced by logic gates and all unnecessary "impurity" can be reduced to a minimum. Logical knowledge as the foundation of modern science and technology, in this sense, is itself technological.

Jean-Pierre Dupuy compares Kantian transcendentalism with AI, especially in the work of the cybernetician Warren McCullough, who had the "intention to take up the challenge of providing a physical basis for synthetic *a priori* judgement."[47] McCullough and Walter Pitts's famous 1943 paper "A Logical Calculus of Ideas Immanent in Nervous Activity" revived the Kantian motive: first, logic is viewed as the founding discipline of human understanding; second, the brain is considered a device that executes logical principles.[48] AI's approach, whether in the form of representationism or connectivism, is no less such a Kantian project. To Dupuy, AI is precisely a naturalization of Kantian transcendentalism effected by depriving it of its subjectivity; that is to say, it becomes a transcendental philosophy without subject. We can probably follow Heidegger and say that the computational mind is one that is deprived of time/care because it is based on purely logical operations. This "timelessness" of the computational mind put an end to metaphysics, as Heidegger might say, because it represents the completion of metaphysics, while a new way of philosophizing needs to begin. The a priori rules in AI are constructed a posteriori, just as the transcendental faculties in *Critique of Pure Reason* are constructed by Immanuel Kant, because they are in the end speculations about how the human mind functions.

We can also see that this metaphysical difference contributes to the opposition between culture and technologies. But if all logical thinking has to be grounded in transcendental imagination, then can we not also see these as two different orders, one coming out of logic, the other out of temporality? In the interpretation of Kant, Heidegger performed a second transcendental deduction (compared to the transcendental deduction Kant discussed in *Critique of Pure Reason*) which proposes temporality as the ultimate a priori of philosophical thinking. Only through the reduction of the transcendental apprehension to time instead of schemas does it regain its transcendence without losing the world. And it is precisely through time that Heidegger opens a broader perspective for critique. For what is most important now is not the collection of pure rules that govern the synthesis but how time makes synthesis possible. This gives us one of the keys with which to resolve the difference of orders. Bernard Stiegler in *Cinematic Time and the Question of Malaise* shows that in the third synthesis of Kant, or the primordial synthesis for Heidegger, recognition demands a spatial exteriorization. It demands that something be re-cognized: something exists, but not in *Dasein*. The recognition hence needs memory support, which is technics. Technics, according to Stiegler, is the "spatialisation of the time of consciousness past and passing as *Weltgeschichtlichkeit*."[49] Stiegler criticizes Heidegger for missing the real problem, which is that the third synthesis "presupposes exteriorisation . . . as the initial force of all projection."[50] Stiegler has discovered here a new organization of time, in which it has to engage the support of memory. The fourth synthesis, a name Stiegler gave to it,[51] has already reconstituted *Dasein* into a technical ensemble. Synchronization, which is the force of imagination, happens according not only to *Dasein*'s own consciousness but also to the time of the technical system.

If this reveals that it is with technology that the third synthesis can function properly as recognition, then we can see a new relation here between transcendental imagination and logic, because techno-logy presupposes λόγος. That is to say, through technics—but not in its pure form—logic returns to its place as the foundation of metaphysics. Technics brings together the two orders of magnitude. If our thesis so far makes sense, then we can ask about the role of the imagination in technics, which entails not only memory or objects for recognition, such as a recording, a drawing, but also programs, algorithms. The works of Jack Goody and Walter J. Ong[52] demonstrate the relation between writing and cognitive processes as involving not only a functional transformation of the body through the use of tools but also a transformation of the mind. Two immediate pieces of evidence are given: first, technics offers us a storage function; second, the emergence of the visual domain (e.g., signs in written form in contrast to speech) made possible a different kind of inspection, a reordering and refining of meanings. Writings are technical objects that deal with single streams of data, whereas digitization allows the logical synthesis of large amounts of data and knowledge exceeding our imagination. This fourth synthesis that came after digitization brought us a new sensibility. This sensibility is no longer to be described in Kant's terms as something purely passive and waiting to be synthesized; rather, it comes with a purpose, a force. The fourth synthesis also has its own characteristics of temporality. I suggest in the following section that we need to understand it through recursivity.

Algorithms as Synthesis

When *Dasein* picks up the hammer and hits the nail, it doesn't usually do this for fun (although it may do) but rather to solve a problem, which requires that it must follow a certain logic and set of constraints. When a tool is put to use, it always follows certain pathways. We can even find this in the hammer, which demands a simple procedure comprising lifting and hitting. If logic sets up rules for reasoning, then we can probably say that an algorithm is a thinking process. Then what is the relation between algorithm and logic? Let's recall the computer scientist Robert Kowalski's equation: Algorithm = Logic + Control.[53] An algorithm is simply a logical operation by which to figure out different relations, and control here merely means the setting up of constraints; given that, for example, the terminal state is one of these constraints, to some extent we should understand constraints also as relations. I propose to tackle the question of algorithms on two different levels: first, in terms of the way it is understood in information science, and second, in terms of what I want to call machine hermeneutics, through a rereading of the history of the concept of the algorithm.

From the perspective of the design paradigm, two principles have to be introduced here, namely, (1) divide and conquer and (2) recursion. Actually, in some textbooks, the former is considered to include the latter,[54] but this obscures the important question concerning recursivity. Here I would like to understand them separately and make recursion the main focus of the discussion. Divide and conquer, as the phrase itself suggests, is a method that divides a problem into subproblems, conquering each subproblem and finally combining all the results to yield the final result. The cleverest and most complicated way of dealing with the subproblem is called recursion. Recursion, if a formal definition is desired, is "an algorithmic technique where a function, in order to accomplish a task, calls itself with some parts of the task."[55] In fact, sometimes we do deal with recursions consciously in our daily lives, for example, Douglas Hofstadter made a joke about this in relation to the German language. German tends to put the verb at the end of the sentence. If grammar is strictly followed, we may hear a professor rambling for an entire lecture and finishing up by squeezing in a string of verbs, while everyone listening has lost track of what he has said.[56] To understand recursion, we have to distinguish it from looping. Let's consider an example: given a number x and given an integer n, compute x to the power n. The looping method will compute each multiplication up to n times within the function itself. The recursive method will divide it into two cases and call the function within the function itself until the condition is met, the running time of the looping function is $O(n)$, and that of the recursive function is $O(lg(n))$, a significant improvement in performance. To make this example even more intuitive, we can imagine that the task is to generate n mirror images: (1) we can

```
Result = 1
Naive-Power(x, n):
        for 1 to n:
         result = x * result
         return result
```

Figure 19. Solution to the problem by a looping function.

```
Recursive-Power(x, n):
      if n == 1
              return x
      if n is even
              y = Recursive-Power(x, n/2)
              return y*y
      else
              y = Recursive-Power(x, (n-1)/2)
              return y*y*x
```

Figure 20. Solution to the problem by recursion.

reproduce them one by one (as in Figure 19) or (2) we can set up two mirrors facing each other, and each mirror reflects the other to *n*/2 degrees (as in Figure 20).

The human mind can make sense of recursion but can hardly keep track of the recursive process.[57] Google's page rank is a recursive function, so that every link has a constant varying weight with multiple relations, and the page ranks are recursively calculated to maintain that they are *"in time," never obsolete.* Our dependence on machines to handle data is due to not only the broadness but also the depth of the process. This vertical dimension is usually ignored in favor of simpler explanations that highlight efficiency and large-scale processing. A recursive function calls itself as many times as possible until a terminal state is reached (i.e., *n* times). Recursion reaches deep down into the question of time. We may recall that Varela wrote, "What defines a machine is relations; the organization of a machine has nothing to do with its materiality, that is to say with the properties of its components that define it as a physical entity. . . . Thus a Turing machine is a certain organization."[58] This statement clarifies the relevance of the connection between algorithm and relations. With algorithms we see a new synthesis of relations, and recursion allows recognition and recollection to happen outside the three syntheses.

If we interpret relation as something ontologically fundamental and time as a type of relation (discursive) as well as a synthesis of relations (existential), then we can arrive at an understanding of what Varela and Maturana called *structural coupling.* I want to show in what follows that this coupling can be grasped in the making-present, or temporalization, of relations. Concerning the extended mind, the understanding of a mere human–tool feedback loop is insufficient. Although Clark *did* mention Varela and Maturana's structural coupling[59] several times in his discussion of the extended mind, he didn't take phylogeny beyond intentionality and remained within a kind of formalism.[60] This is why Hubert Dreyfus made the criticism that the concept of the extended mind falls into the Cartesian paradigm and shows merely "cases of temporal austerity—no rates and rhythms are involved."[61]

Recursivity and Computational Hermeneutics

The preceding understanding of algorithm as recursion remains technical and not sufficiently philosophical; to make it so, we need to go further into the question of recursivity and its significance in logic and mathematics. In his book *An Early History of Recursive Functions and Computability: From Gödel to Turing,*[62] the mathematician and historian of mathematics Rod Adams has outlined the development of the concept of recursivity in mathematical proofs from the mid-nineteenth century until the time of the Turing machine. In Adams's account, Richard Dedekind was the first mathematician to use the term definition by recursion, in his 1888 essay "Was sind und was sollen die Zahlen?" (What are numbers and what should they be?), where he used it to deal with mathematical induction. This becomes quite clear in Dedekind's examples, shown in Figure 21.

What does it mean to understand a number recursively? It entails the transformation of a number into a recursive function. This change becomes significant when we consider two further developments in mathematics. The first was Thoralf Skolem's 1923 paper "The Foundations of Elementary Arithmetic Established by Means of the Recursive Mode of Thought, without the Use of Apparent Variables Ranging over Infinite Domains." Skolem wanted to get rid of the notions of existence and universals

Addition	$m+1=m'$
	$m+n'=(m+n)'$
Multiplication	$m.1=m$
	$m.n'=m.n + m$
Exponentiation	$a^1 = a$
	$a^{n'} = a.a^n = a^n.a$

Figure 21. Some recursive schemes of mathematical operations proposed by Richard Dedekind.

in Bertrand Russell and Alfred North Whitehead's *Principia Mathematica,* in which they often used the quantifiers "always" and "sometimes." As a result, Skolem replaced existence with recursive functions. *If consistency can be thought in terms of recursive functions, that means ontology no longer has priority over operation but the order is reversed*:

> If we consider the general theorems of arithmetic to be functional assertions and take the recursive mode of thought as a basis, then that science can be founded in a rigorous way without use of Russell and Whitehead's notions "always" and "sometimes." This can also be expressed as follows: A logical foundation can be provided for arithmetic without the use of apparent logical variables.[63]

The second move is Gödel's development of the general recursive function as an equivalence to the Turing machine. The Turing machine and Church's lambda calculus, as we know today, were responses to the *Entscheidungsproblem* posed by David Hilbert, which we briefly discussed in the last chapter. Hilbert's conception of algebra and geometry was different from those of mathematicians before him. The ambition of Hilbert was to reduce mathematics to symbolic logic so that all proofs could be reduced to formalized procedures. The *Entscheidungsproblem* concerns the computability of a natural number, and both Turing and Gödel showed that a solution to Hilbert's problem was impossible. Yet it was also by addressing this problem that Turing was able to develop what is today known as the Turing machine.

Turing's response to Hilbert's question involves a thought experiment that imagines a strip of paper tape of infinitive length, consisting of squares; there is a header that can read the symbols in the squares, compute them, and give a corresponding state as output. In Turing's conception, there are a few significant conditions: (1) he posits an idealized human computer whose state of mind is defined by the symbols upon which she is operating, (2) he requires that the computation process can be mimicked by a Turing machine, and (3) "the number of states of mind which need be taken into account is finite."[64] The mechanization of the mind is realized in the Turing machine as a mathematical tool for proof. This is clear from the formulation of the well-known Church–Turing hypothesis: "The intuitive notion of algorithms equals Turing machine algorithms."[65] It is in Gödel's proof that we find the equivalence between recursion and the Turing machine. Gödel's 1931 paper titled "On Formally Undecidable Propositions of Principia Mathematica and Related Systems" contains his theory of recursiveness. In contrast to the formalization of symbolic logic, Gödel arithmetized the formal systems with numbers (known as Gödel numbers) so that the relations between different axioms could be expressed numerically. This new coding scheme follows the same logic of Hilbert's treatment of symbols—in themselves, they are meaningless.[66] Today when we write a computer program, we can write a nonrecursive function, but we can basically reduce every operation and number to recursive functions. Because it is a process that is to a large extent independent of observation, this hermeneutics cannot be grasped as a separate process of the imagination. A recursive function only comes to a halt when a certain terminal state is reached, while within the process, what is in the past is always ahead, because each function is expecting something to come, something that will bring the procedure to a close. When both humans and machines are understood from the fundamental perspective of relations, it produces a new faculty, which, as indicated earlier, I term *tertiary protention,*[67] as a response to Stiegler's tertiary retention (as well as based on it).

Tertiary Protention

How then can we grasp tertiary protention as a new synthesis of relations? Let's consider an example: you go home after work, tired and sleepy; when you open the door, a freshly made coffee is already there waiting for you. The machine has prepared the coffee for you before you have decided to have one, because it knows that you would like (or will want) to have one. This is one of the examples of tertiary protention working from a distance, that is to say, of the imaginative force exerted from the outer world. Well-collected and structured data and efficient algorithms make very good predictions of our movements, and we can no longer say that they are just retentions. The whole discipline of network analysis and human mobility analysis is dedicated to the study of statistical predictions. Without algorithms, digital objects would be mere retentions residing on the hard drives of computers and servers. Through the analysis of data—or, more or less, through speculation—the machines are able to produce surprises (not just crises) by identifying a possible (and probable) "future," a specific conception of time and space that is always already ahead but that we have not yet projected. We then see that tertiary protention is important for pre-pre-predicative experience, which in turn becomes our primary and secondary retention.

We can probably understand the synthesis of tertiary protention in both spatial and temporal dimensions through one of Heidegger's key concepts, "making-present" *(vergegenwärtigen)*. Making-present means bringing something forth into the "now." Making-present is different from recalling, which means to bring the representation or imagination of something before us with the use of concrete figures, colors, narratives. In contrast, making-present is the ability of *Dasein* to make sense of anything, even if it doesn't exist or isn't known, without thematization. For example, I can make-present a book by Heidegger even if I don't know anything about its cover and content. The making-present is a function of time that is grounded in the *vor*-structure. It is a prethematic experience of things enabled by the already there in which I am situated; it is an outward movement to the world as temporal ecstasy. Heidegger illustrates this through the example of encountering the Feldberg Tower in the Black Forest:

> In making-present we are not drawing upon memory as if we were searching around inside ourselves for representations. We are not inwardly directed. On the contrary, when we make-present the thing we are outside with it, oriented towards the tower, so that we can bring before ourselves all its properties, its full appearance. It can even happen that we can see the thing much more clearly and fully in making-present *[Vergegenwärtigen]* than in the having present *[Gegenwärtigen]* of immediate perception. Suddenly we have something before ourselves which, as we say, we "didn't notice" in immediate bodily seeing. But it is not representations,

> images, memory-traces and the like, that we have before ourselves; it is rather that to which this having-before-oneself is directed, and solely directed—the existing tower itself.[68]

For Heidegger, making-present is contrasted against the present-at-hand, which presupposes a thematization, whereas making-present also means imagination. This seeing is also a process of making things intelligible by moving *Dasein* to the thing intended. It has the same logic that we discussed earlier in terms of the temporal-ecstatic relations involved when one says "the roses are blossoming." Now, to make-present is to make sense of the meaning of objects as distinguished from their background, not through extraction, but through *Dasein*'s bodying-forth. This is very different from the Husserlian pre-predicative or predicative experience, because for Husserl, the pre-predicative experience is merely a passive sense impression, and the predicative experience is an intentional thematization. We might ask whether this hermeneutic recursivity implies a mode of languaging of machines because it is not only about predication but also about processing. If tertiary protention can be grasped as a mode of languaging, then we can see that a dialogue or negotiation has already taken place before each intentional grasp.

This languaging is different from our daily use of saying "think of a cup," which brings forth a memory or idea of a cup. Rather, it means to orient, that is to say, to intuitively manifest the complex of relations on its own.[69] This represents an important connection to our discussion of relations. Heidegger uses the example of driving: if you cannot make your home present when you are driving, you will never reach home. Indeed, *Dasein* is its relation to the world.[70] To make something present is to produce the relations involved and hence to orient. What is meant by orientation? Orientation is the way we synthesize relations of different natures and are thereby able to make a corresponding decision. When a mountaineer is hiking in the mountains, he discerns his path by making judgments based on the correspondence between the map, the stars, and the landscape. Orientation is not quite a question of space but more one of relations; in fact, it is probably fair to say that space in this context becomes one type of these relations. "I" is always already "in" somewhere. But the "in" is not a physical present, as when, for example, when we are *in* the forest. "Being-in" is a movement toward something significant and meaningful, so the "in" is at the same time "outward." In the digital milieu, there is no space but only relations. The primary function of digital technologies, as we can see, is not merely to represent objects but to materialize and accumulate relations. And without these relations, there is no transparency of action. The real time and immediate experience of the world reach far beyond human sight: things can be zoomed in on, zoomed out from, mixed up, rearranged. Without these data, one gets lost in the digital milieu, causing a sense of frustration and indecision. These relations are dynamic as well as imaginative. Every retrieval recursively refers to the present from the future.

In our investigation, we attempted to understand the opposition between logic and transcendental imagination, which constitutes the fundamental problem of metaphysics. We then sought to resolve this difference by mediating through technics of relations. We have also made a reduction here. This reduction is a negation neither of logic nor of time but rather a search of a ground with which can we talk about the fourth synthesis. The making-present of the machine belongs to its ability to synthesize relations, which implies a shift from the understanding of qualitative data as sense and perception to the synthesis of qualitative data. In a network with rich metadata, our attention to the changes in the direct experience of time, of orientation, is demanded. Over the past few decades, the vast changes that transformed the Internet concretized and materialized relations and sped up their synthesis. Different kinds of digital objects that congeal different forms of sociality and temporalities are becoming more and more important in orientation. This is a departure from Heidegger's critique of technology and logic, in which there is a sense of crisis due to the replacement that he foresees: that is, metaphysics will be replaced by cybernetics, language by logic, things replaced by objects, and so on. Logic doesn't have temporal-ecstatic potential in its intrinsic nature, but it gains its position through *synthesis* rather than *replacement.* And it is precisely in the perpetual process of synthesis that the making-present, which has its origin in the synthesis of apperception, becomes technologically and quantitatively dependent.

If we allow the tertiary protention to enter into the transcendental imagination, then we can probably resolve the preceding opposition, as well as the one between Ontology and ontologies. Heidegger believed that the third synthesis, *Vorbildung,* was the most fundamental among all the other syntheses of Kant. This prioritization of the *Vorbildung* is twofold; on one hand, it designates the last step of *Dasein*'s making-present after apprehension and recollection; on the other hand, it is also the preparation for entering the second circle of the formation of image, that is, a new circle of *Abbildung* and *Nachbildung*. For in the next "now," what is perceived has a causal relation to what is before it. For example, someone points out to me something from a distance, then I follow his indication, and I see the object. Now we have the fourth synthesis, which is not an image *(Bild)* but a function that traverses and reorganizes other syntheses.

Repetition after the Fourth Synthesis

The question of technological convergence, first through networks, second through the intervention of imagination, announced the end of humans as holding the central position among objects and being at the center of knowledge—because humans now have to adapt to the rhythm of the technical system, not only physiologically and materially, as Marx described, but also cognitively (making-present). If we take the fourth synthesis as one of the features of the new technological system, we will easily arrive at the impression that we are more closely tied to other parts of the technological system. This convergence takes on another nature that no longer presents itself in a network form but is instead closer to symbiosis, as defined here by the computer scientist J. C. R. Licklider:

> The fig tree is pollinated only by the insect *Blastophaga grossorun.* The larva of the insect lives in the ovary of the fig tree, and there it gets its food. The tree and the insect are thus heavily interdependent: the tree cannot reproduce without the insect; the insect cannot eat without the tree; together, they constitute not only a viable but a productive and thriving partnership. This cooperative "living together in intimate association, or even close union, of two dissimilar organisms" is called symbiosis.[71]

We are approaching such a state of symbiosis with machines, indeed, it is probably already here in some contexts. But is this really something that we should celebrate, or is the logic of symbiosis as an ontological understanding in itself problematic? In such a vision, the perfection of the fourth synthesis reconstructs the organization of images. Indeed, the transcendental imagination is becoming a passive force of synthesis, because the recognition process can be short-circuited: the future is always the present. Deleuze, in *Difference and Repetition,* has identified this temporal structure as the third synthesis of time. The first synthesis of time is the time of habitudes, the Humean time that we discussed earlier in this book; the second synthesis of time is the active and passive synthesis of memory; the third synthesis of time is the repetition "by excess, the repetition of the future as eternal return."[72] It is clear that Deleuze wasn't thinking about the tertiary protention of algorithms and digital objects; he was addressing the temporal constitution of subjectivity through three syntheses of time. In contrast to the repetition of passive habitudes and the repetition of memories, the third synthesis of time as the repetition of the future is the highest level of synthesis: the eternal return of the not-yet-present. Deleuze takes a similar path to Heidegger in taking time as the foundation of subjectivity, which is the form of the determinable in addition to the "I think" (determination) and "I am" (undetermined). Deleuze saw this as the cerebral response of Kant: "the form under which undetermined existence is determinable by the 'I think' is that of time."[73]

The fourth synthesis that we have derived from the reading of Heidegger's critique of logics contributes to another formulation of time, taking up my past and the past of those who I don't know. It gives us a new form of determination that is not "I think" but "I guess you think . . ." We call it tertiary protention. The active synthesis of the tertiary protention gives us a future that is present, like the third repetition of Deleuze, in which "the present is no more than an actor, an author, an agent destined to be effaced; while the past is no more than a condition operating by default."[74] In the affirmation of the third repetition, we see also a detachment of the future and memory. Because neither memories nor habitudes are the determining factor any more, the projection is already there before their synthesis. Through the spatialization of both habitudes and memories in digital objects, the algorithms have already produced the synthesis without consulting the other syntheses. The third repetition is the repetition of signs, of symbols, of objects that I have encountered or that I may have encountered. Commenting on this third repetition, Deleuze wrote, "As Klossowski says, it is the secret coherence which establishes itself only by excluding my own coherence, my own identity, the identity of the self, the world and God."[75] For Pierre Klossowski, this repetition consists of the deepest thought of existence in the philosophy of Nietzsche.[76] Deleuze's comment on this coherence is illuminated by Pierre Klossowski's answer to a question about intensity posed by Jean Wahl (in a discussion at which Deleuze was also present):

> It is about coherence: the perfect coherence of the circle as sign challenges my proper coherence in the way that I depend solely on a system of signs which suppose a beginning and an end, once for all. So the circle as sign, exerts on me a constraint that, in sum, demands, poses this dilemma: either you become mad, or you create an equivalence to your madness, and this is the Nietzschian tragedy. He prefers becoming mad to looking for a coherence.[77]

This coherence is re-created in the coupling of the distribution of intensities already there with signs. The signs produce an amplification effect in the circle that leads to a change in structure. In this repetition, there is a will that determines its becoming: madness or its equivalence. But doesn't this replacement of the tertiary protention here cause a risk or even a danger to this coherence? Signs produced through tertiary protention could turn the third repetition into habits, as is happening now with personalizations and recommendations on the Web. That is to say, it produces a kind of disindividuation (in a destructive sense instead of simply a phase change) by interfering in the synthesis of time. If we follow the analysis of Heidegger, we find this problematic formulated as the disruption of care. In *Being and Time,* Heidegger analyzed care as the primordial form of existence. On the basis of this understanding of care as time, he was able to analyze different structures of care, for example, the *Besorgen* that we have discussed. Heidegger further proposed to analyze *Fürsorge,* which is designated for analyzing the human *Dasein* who has the structure of Being-with. *Fürsorge* at the same time denotes worries about not being able to be there and the affirmation one can have of oneself. If we may put it this way, the former is passive, in the manner of affections, emotions; the other is active, involving anticipations and preparation for the future. What is crucial in *Fürsorgen* is the act of "looking back." Heidegger uses two words, *Nachsicht* (forbearance) and *Rücksicht* (considerateness), to describe the double nature of *Fürsorgen* as encompassing both worries and affirmations. We can interpret *Rück-* as a spatial relation and *Nach-* as a temporal relation, so taking care has both temporal and spatial dimensions, whereby the action of looking back gives us imagination. Deleuze provided a similar interpretation when he wrote:

> The role of the imagination, or the mind which contemplates in its multiple and fragmented states, is to draw something new from repetition, to draw difference from it. For that matter, repetition is itself in essence imaginary, since the imagination alone here forms the "moment" of the vis repetitiva from the point of view of constitution: it makes that which it contracts appear as elements or cases of repetition.[78]

The "looking back" characterizes the primordial structure of *Dasein*'s own care, by which imagination is possible. The production of the tertiary protention, which situates future as present, prevents access to the past as the primordial mode of the "I think." This problematic is similar to that of *das Man,* because they can both present themselves as distractions; *Dasein*'s horizon is obscured by the invisibility that prevents it from penetrating into the question of Being. The fourth synthesis constitutes a new horizon that can further obscure the question of Being, because seeing is always already directed toward certain destinations before thinking arrives. That is to say, all *synthesis* has the possibility of becoming *syndosis. Das Man* is the "they" or the public that brings *Dasein* to the place where one loses oneself and the collective. *Das Man* is not social, it is not a community, but a fictitious "We"—another name for the consumer. Heidegger seems to have already anticipated this when he wrote,

> The characteristic of the latter *[information]* is precisely to obstruct, from the beginning, our access to the forma, the essence, and the proper character of the being of things. Information precludes our ability to see forma.[79]

The organization of digital objects through the standardization of data structures and the invention of algorithms is not simply what has fashionably been called the "organization of knowledge" but is also the organization of time. The making-present has its primordial mode of bodying-forth to the world, is redirected to the abstractness of the pseudo "We" and "I." The imagination based on the programming of intersubjectivity through interobjective relations is an attempt to enact this, and it is no surprise to find that social norms are increasingly easily formed because of this programmability. That is to say, technological normativity is the source of social normativity.

Milieux after Systems: Toward a Mechanology

The industrialization of categories and algorithms has become the fundamental agent in the synthesis of time today. All kinds of censors, CCTV, and pattern recognition technics are contributing to the new form of protention. This is a technical tendency, rather than a technical fact, accompanying the digitization process. Modern technologies bring us much convenience, but this convenience as an expression of convergence (in terms of functionalities as well as of time and space) also threatens to replace care structures (both individual and collective) with the machine form of "care." In fact, we are already experiencing many of these situations, from reminders to automatic updates and recommendations. This highlights the urgency not only of discussing the status of human beings but also of searching for a new structure of care (a task Bernard Stiegler has already made a concerted effort to undertake), without simply negating this tendency and evolution. The debate regarding the primacy of logic versus imagination points to a fundamental metaphysical question: a fundamental Ontology can no longer be fully grounded without taking technical systems into account. If I may simplify, I would say that philosophy in the first half of the twentieth century endeavored to understand human existence ontologically. In the second half of the century, the deconstruction of the concept of the human through the discovery of its dependence on the prosthesis of technics led to the concept of the inhuman or posthuman, but this understanding is still ontological in the sense that it seeks to categorize the inhuman. We can also understand from this perspective the rise, and eventually the triumph, of the phrase technical system over technical milieu. But when we take technology into account, such an ontological understanding doesn't have much to say besides expelling the human from the center. The fact is that we cannot even derive an ontology of technology, because it may not even exist. It is probably more appropriate to follow what Simondon calls ontogenesis. If this book has succeeded in bringing this point to light, the implication is that a new critique or conceptualization of the human–inhuman should take technical systems into account to analyze them together as relations.

Simondon didn't explicitly express as much, but his analysis of the associated milieu points in a similar direction. His conceptualization of human beings as technical beings, and as technical individuals at a certain moment of history, shows that a relation between the living being and technology needs to be analyzed technically. This gives us the imperative to discuss milieux after systems—another retrieval *(Wiederholung/répétition)*. The associated milieu is not a milieu that is outside of technical objects; on the contrary, the associated milieu is inside the technical individual and the technical ensemble, serving at the same time the role of a natural milieu and a functionality, as shown in the example of the Guimbal turbine, where the river is the associated milieu of the engine. The river drives the turbine, engendering its movement, while at the same time it takes away the heat produced by the engine (though this energetic efficiency is unlikely to carry over into the ecological effects upon the other organisms in the river). The associated milieu is not a structure. A milieu has a recurrent causality, whereas a structure does not. Structures are forms, like ontologies. Forms are at the front, but they also need a ground, because it is the ground that carries them. Without the ground, forms cease to be. The ignorance of the relation between form and ground has been the source of erroneous thinking in the analysis of imagination:

> Until today imagination has been badly analysed, because forms have been invested with a privilege of activity and considered as having the initiative of the psychic and physical life.[80]

Such a misunderstanding leads to the inability to solve the problem of alienation: because for Simondon, alienation is due to the rupture between form and ground, the associated milieu can no longer regulate the dynamics of forms. That is to say, forms affect the ground in such a way that the ground is not able to maintain its own coherence.[81] In this analogy, life is the ground and thoughts are forms. Without life, there is no thinking being. We can also say that between discursive relations and existential relations, which constitute care, there is a similar relation between forms and ground. Now, because of the technology of digitization, we can easily materialize, analyze, and transform discursive relations into material forms. But for a transformation to be carried out, we should bear in mind how these forms contribute to the ground, both in terms of technical compatibility and the structure of care. The question is, how are we going to identify the concurrent causality between these two orders, and hence to reorganize the associated milieu and its corresponding relations? The details certainly vary from one case to another, but an analysis of the ground is necessary before the forms can be transformed. This could be the general principle for the discipline Simondon envisaged: mechanology. Such a philosophically and technologically informed discipline, which would work against alienation, is still in its very early stage. Here I can only offer an example to demonstrate how this could be thought through in terms of technological development, and I would like to use this example to conclude this chapter by outlining how a metaphysical critique could be realized in material terms.

One of the projects that I worked on with Bernard Stiegler and Harry Halpin at the Institut de Recherche et d'Innovation, starting in 2012, aimed to develop a new concept of the social network as an alternative to Facebook.[82] I started with a study on the materialization of social relations, which we can trace back to the method of sociometry developed by the American social psychologist Jacob L. Moreno. Moreno was one of the first sociologists to demonstrate the value of graph-theoretical approaches to social relationships. The most often quoted example is Moreno's work at the New York State Training School for Girls in Hudson, where the runaway rate of the girls was fourteen times higher than the norm. Moreno identified this as being a consequence of the particular network of social relationships among the girls in the school, which he followed by creating a simple sociological survey to help him "map the network." The survey was based on simple questions such as "who do you want to sit next to?" Moreno found from the map that the actual allocation plan of the girls in different dormitories created conflicts; he then used the same model to propose another allocation plan that successfully reduced the number of runaways. His belief in the value of representing social relations by "charting" prompted Moreno to write that "as the pattern of the social universe is not visible to us, it is made visible through charting. Therefore the sociometric chart is the more useful the more accurately and realistically it portrays the relations discovered."[83]

These relations are what we have called discursive relations here, in this case materialized as lines and numbers on the map. We may also observe that in Moreno's methodology, every individual was considered a social atom; the society represented on this basis is a network composed of social atoms linked together by discursive relations. Here we see a clear instance of neglect of the question of the ground, as forms are taken as the totality. Individualism is promoted through technological networks. In 1933, when Moreno published in the *New York Times* an article titled "Emotion Mapped," he suggested drawing a sociometric map of New York City: in fact, he was only able to produce such a representation for a community of 435 people, yet nowadays, with tools such as Facebook, Moreno's dream is no longer impossible.[84] Social networking websites like Facebook stay within the sociometric paradigm by materializing social relations in terms of digital objects and allowing new associations based on different discovery algorithms to emerge. If we look at the Graph API that defines the core data structure of Facebook,[85] we should not be surprised to find that the analysis of digital objects in the earlier chapters of this book is applicable.

We can identify several core factors that lead to alienation in this new industrial model. Specific to our discussion here, within this network, we can say that time and, equally, the attention of each social atom are sliced into ever smaller pieces and dispersed across the networks by status updates, interactions, advertisements—the mechanisms of tertiary protention—for marketing purposes. One can spend hours on Facebook out of curiosity without achieving anything. The "collective" on Facebook becomes a distraction. The core idea of our project is to develop a group-based social network based on Simondon's concept of collective individuation. In this conceptualization, projects—which must also be understood here as projections—are prioritized instead of being subject to the random status updates of individuals. In the projection of a project, we are already ensconced in the question of care, of *Fürsorge,* that reorganizes the structure of time in favor of its own integrity. The question, then, is, how can we transform individuals into groups? One of the answers that we proposed is through finding mechanisms to regulate these relations, in other words to set up what I call creative constraint. That is to say, after registration, the user can only use the full functions when he or she participates in a group or creates a project. This rearrangement of relations makes the group and project the default instead of the individual. The group can have liaisons with other groups and create intergroup relations, which comprise a milieu. In this sense, we can see that the project and the group become the associated milieu for the individual and other groups and also the mediators between discursive relations and existential relations.

This last chapter ends with this example as an illustration of how the question of convergence can be appropriated and practically realized within the framework of the theory of relations that we have developed here. The aim of going through such a long detour from Heidegger to Deleuze, from logic to algorithm, was to propose how technics is fundamentally philosophical, if not metaphysical, and how philosophy is as practical and technical as one may think technics to be. At stake, as shown in this chapter, is the synthesis of time produced by algorithms. Engineers are building the world: as Tim Berners-Lee proudly announced, the experts creating the Web are philosophical engineers, and the semantic web is a philosophical engineering project. The purpose of this book is to show how much more broadly it is possible, and necessary, to reflect on the issues raised by technological development by meditating on digital objects. The technical system is already here, and a more rigorous method needs to be invented that will at the same time be theoretically informed and practically realizable. Some art practices may have given us some insight into the development of techniques, but a more systematic approach must be developed, and I hope in this book to have succeeded in outlining some entry points into the further development of such thinking.

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THIS BOOK IS AN EXERCISE and an experiment that have taken almost ten years of time, across three periods of study and research in London, Paris, Berlin, and Lüneburg. This work is indebted to many thoughts and people I came across during these years in Europe after leaving Hong Kong in 2006. Two critical moments in 2008 shaped the direction of this research and its method: a critical illness shed new light on a reading of Heidegger's *Sein und Zeit,* concerning death, technologies, and friendship, and later in the year an encounter with Professor Bernard Stiegler shaped the style of the book's philosophizing, which became a dialogue between Heidegger and Simondon, not only as a question of digital objects but also as a question of existence. The generous support and patience of Professor Matthew Fuller and the inspiration of Professor Scott Lash since the London years were crucial to the completion of this work.

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Notes

Foreword

1. Martin Heidegger, *Schelling's Treatise on the Essence of Human Freedom,* trans. Joan Stambaugh (Athens: Ohio University Press, 1985).

2. Gilbert Simondon, *Du mode d'existence des objets techniques* (Paris: Aubier, 1999), 61–65.

3. Mats Alvesson and André Spicer, "A Stupidity-Based Theory of Organizations," *Journal of Management Studies* 49 (2012): 1194–220.

4. He studied these disciplines, along with analytical philosophy, in Hong Kong, then studied Continental philosophy at Goldsmiths, University of London, which is where I met him and where he defended his thesis, which is the origin of the present work. We have since worked together, alongside Harry Halpin, in the framework of the Institut de recherche et d'innovation in Paris, of which I am the head.

5. Here we must recognize that Yuk Hui is also a reader and appreciator of Rimbaud. In a lecture at the University of Kent in November 2014, he analyzed Heidegger's commentary on Rimbaud's "Lettre du Voyant": "In Greece . . . poems and lyres turned Action into Rhythm. After . . . poetry will no longer beat within action; it will be before it."

6. Vincent Bontemps, "Quelques éléments pour une épistémolgoie des relations d'échelle cher Simondon," *Appareils* 2 (2008), http://appareil.revues.org/595.

7. "How about things that we cannot experience, or that we can call nonexperience, such as the execution of an algorithm that gives us the givenness of digital objects? . . . We cannot have an experience that an electron has just struck our skin, but we can imagine it; in like manner, we cannot experience the algorithm itself, but we can more or less imagine it within the limits of our cognitive capacity. What happens when such nonexperiences now concretely participate in our imagination?" (chapter 6).

8. The reticulated digital object weaves "a *programmable memory* that largely distinguishes between the technical objects of Simondon and Heidegger and digital objects as the technical *milieu* and programmable *context.* This gives us the second "given" of the word *datum* (the first referring to sense data)." These analyses of the digital object are conducted through examples of the everyday

features of the twenty-first century: "We finish this chapter with an example of our experience on YouTube to illustrate how the milieu has taken on a different role" (chapter 3).

9. In 1901, in section 6 of the Fifth Logical Investigation, Husserl posited that a consciousness is a flux consisting of retentions and protentions. In 1905, he took these studies of the retentional and protentional structure further and established that we must distinguish primary retentions, which constitute the temporality of perception, from secondary retentions, which form the recollections of memory, that is, consciousness of the past. In 1936, he posited in *The Origin of Geometry* that writing is the condition of constitution of the flux of consciousness in which geometric thought forms. I call tertiary retention the written grammatization that allows control to be taken of primary and secondary retention and the projection of those new forms of protention constitutive of Greek *logos* (and I have extended the concept of tertiary retention to all forms of mnesic exteriorization—which commence at the beginning of hominization). This grammatization is a spatialization of time, and it is spatialization that enables control and, in return, the retentional and protentional release of writerly and readerly consciousness. On this question, see also Bernard Stiegler, *States of Shock: Stupidity and Knowledge in the 21st Century,* trans. Daniel Ross (Cambridge, Mass.: Polity Press, 2015), 108–21, for an analysis of reading and writing as conditions of the speculative proposition in Hegel's *Phenomenology of Spirit.*

10. In the section titled "Recursivity and Computational Hermeneutics," Yuk Hui writes in chapter 6, "Today when we write a computer program, we can write a nonrecursive function, but we can basically reduce every operation and number to recursive functions. Because it is a process that is to a large extent independent of observation, this hermeneutics cannot be grasped as a separate process of the imagination."

Introduction

1. https://developers.facebook.com/docs/reference/api/.
2. Aristotle, *Categories,* 2a13–2a18, 4.
3. Gilson, *L'être et l'essence,* 51.
4. Aristotle, *Metaphysics,* 1028b4, 168.
5. Ibid., 172.
6. Marx, *Introduction to Aristotle's Theory of Being as Being,* 36. Marx equates *eidos* with *morphe,* which nevertheless has to be closely distinguished.
7. Rotenstreich, *From Substance to Subject,* 2. "Substance was placed in the order of things, and subject in the order of ego or mind, or else ego in Kant's sense, the unity of subject."
8. Ibid., 1.

9. Stern, *Hegel, Kant, and the Structure of the Object,* 10, points out that substance bears the name "real essence." For Locke, see also Locke, *An Essay Concerning Human Understanding,* 442.

10. Hennig, "What Is Formal Ontology?"

11. Frank, *Eine Einführung in Schellings Philosophie,* 43.

12. Tilliette, "L'absolu et la philosophie de Schelling," 208.

13. Verene, *Hegel's Absolute,* 6.

14. Hegel demonstrates this with the example of a figure distorted by the refraction of light through water. The philosophical investigation is undertaken to explain, not the principle of refraction of light itself, but rather the experience of it, which constitutes the true knowledge.

15. Hegel, *Logic of Hegel.*

16. Hegel shares Goethe's opposition to the Newtonian understanding of white light as the spectrum of colors and interprets it rather as a unity between light and darkness; see Stern, *Hegel, Kant, and the Structure of Objects,* 80.

17. Heidegger and Hegel, *Hegel's Concept of Experience,* 20.

18. Ibid., 22.

19. Husserl's connection with Hegel, in my view, can be made through Heidegger, especially through his understanding of Hegel's concept of experience and Husserl's notion of categorial intuition.

20. The absence of technical objects in Husserl is further elaborated by Bernard Stiegler in *Technics and Time,* vols. 1 and 2. Stiegler has shown that Husserl was able to talk about primary and secondary retention, but not tertiary retention, which is one of the most important elements of technical objects.

21. It is also because of the Industrial Revolution that philosophy of technology started to emerge in Europe in the nineteenth century, especially in Germany, with figures such as Ernst Kapp (1808–96), Manfred Schröter (1880–1973), Friedrich Dessauer (1881–1963), Martin Heidegger (1889–1976), Günter Anders (1902–92), and in the twentieth century in North America, with figures such as Lewis Mumford, Albert Borgmann, Don Ihde, Carl Mitcham, and Andrew Feenberg.

22. Heidegger and Boss, *Zollikon Seminars.*

23. Simondon, *On the Mode of Existence of Technical Objects,* 39.

24. Simondon, *Du mode d'existence des objets techniques,* 56.

25. Simondon, *L'Individuaton à la lumière des notions de forme et d'information,* 79.

26. Simondon, "Genesis of the Individual," 297–319.

27. Simondon, *L'individuaton à la lumière des notions de forme et d'information,* 83.

28. Harman, *Tool-Being,* 3.

29. Ibid., 66.

30. Ibid., 5.

31. Harman, *Guerrilla Metaphysics,* 88. Harman proposes that substance and relations are interchangeable.

32. Leibniz, *De Progressione Dyadica.*

33. Widmaiter, *Die Rolle der Chinesischen Schrift in Leibniz' Zeichentheorie,* 25.

34. Chaitin, "Leibniz, Information, Math and Physics."

35. Ibid.

36. Fredkin, "An Introduction to Digital Philosophy," 189.

37. Ibid., 195.

38. Floridi, "Against Digital Ontology."

39. Quoted by Floridi, "Philosophical Conceptions of Information," 13–53.

40. Weaver, "Recent Contributions to the Mathematical Theory of Communication," 103.

41. Floridi, "Peering into the Future of Infosphere."

42. Ibid.

43. Floridi, "Web 2.0 vs. the Semantic Web."

44. Hui, "Simondon et la question de l'information."

45. Lyotard, *Postmodern Condition.*

46. Lecourt, *L'épistémologie historique de Gaston Bachelard,* 25.

47. Ibid.

48. G. Bachelard, *La nouvelle esprit scientifique,* 129.

49. Sloterdijk and Heinrichs, *Die Sonne und der Tod,* 137–39.

50. Russell, *Principles of Mathematics.*

51. Ibid., section 24.

52. Ibid., section 29.

53. Tuple literally means a group of variables, for example, (plant, animal), (3, 5). The TRC is based on specifying a number of tuple variables that range over a relation. It can be illustrated with a simple example. Consider a company that has the following information inside its relational database: EMPLOYEE (SSN, Name, Bdate, Address, Salary, Dept Id); the query of a TRC would be something like "Find all employees whose salary is greater than 30.000," or $\{t|t \text{ EMPLOYEE} \wedge t.\text{ Salary}>30.\ 000\}$.

54. DRC uses domain variables (instead of tuples) that take values from an attribute's domain. Consider the same example we used in the previous footnote: find all employees whose salary is greater than 30.000, or $\{< id,n,b,a,s,d>|< id,n,b,a,s,d > \text{EMPLOYEE} \wedge s > 30.000\}$.

55. Ellul, *Technological System,* 102.

56. Simondon, *Du mode d'existence des objets techniques,* 302.

57. Bontems, "Quelques éléments pour une épistémologie des relations d'échelle chez Gilbert Simondon."

58. Lecourt, *L'épistémologie historique de Gaston Bachelard,* 24–25, quoted from G. Bachelard, *Essai sur la connaissance approchée,* 78.

59. Tiles, "Technology, Science, and Inexact Knowledge," 167.

60. Simondon, *Imagination et invention,* 165.

61. Bontems, "Quelques éléments pour une épistémologie des relations d'échelle chez Gilbert Simondon."

62. Kant and Pluhar, *Critique of Pure Reason,* A 426–27, B 454–55.

63. G. Bachelard, *Essai sur la connaissance approchée,* 181.

64. De Carvalho, *Poésie et science chez Bachelard: liens et ruptures épistémologiques,* 119.

65. G. Bachelard, *La nouvelle esprit scientifique,* 129.

66. See Heidegger and Lovitt, *Question Concerning Technology.*

67. Simondon, *Du mode d'existence des objets techniques,* 72.

68. Heidegger, "Letter on Humanism," 221.

69. Heidegger, "Question Concerning Technology," 333.

1. The Genesis of Digital Objects

1. Haynes, *Visa Takes to Second Life.*

2. http://www.etymonline.com/.

3. Simondon, *Imagination et invention,* 139.

4. One of the most controversial of these is the CYC project, which aims to build an ontology of commonsense knowledge. It was started by Douglas Lenat in 1984; the Naïve Physics project proposed by Patrick Hayes in the 1980s was in a similar vein.

5. Berners-Lee, *Weaving the Web,* 222.

6. Nelson, *Literary Machines,* 0/2.

7. Nelson, "New XANADU Structure for the Web."

8. Alesso and Smith, *Thinking on the Web,* 69. "Knowledge representation is currently in a state comparable to that of hypertext before the advent of the Web."

9. Berners-Lee, *Axioms of Web Architecture.*

10. Howarth, "Metadata and Bibliographic Control," 44.

11. http://marc-must-die.info/.

12. Simondon, *Du mode d'existence des objets techniques,* 10.

13. Ibid., 15.

14. Simondon, *L'individuation psychique et collective,* 132–33. The Belgian philosopher Pascal Chabot in *La philosophie de Simondon,* 112, summarized individuation as being transcendental and individualization as being empirical. In fact, this does not seem to be Simondon's intention at all.

15. Simondon, *Du mode d'existence des objets techniques,* 22.

16. Simondon, *On the Mode of Existence of Technical Objects,* 74.

17. Ibid., 68–69.

18. The terms *constraints* and *overdetermination* are necessary because they define the functionality and calculated possibility of the technical individual. For example, you can drop a computer in the water, something that may not be considered

in the overdetermination (if it is not waterproof), but the computer's ability to turn itself off when the CPU is overheated is within the overdetermination.

19. Simondon, *Du mode d'existence des objets techniques,* 78.

20. A reciprocal causality can be illustrated with Simondon's example of the operation of a turbine surrounded by water: the water can absorb the heat generated by the turbine for other purposes, while at the same time the water has a cooling effect on the machine. There is a reciprocal process within this interaction of the two elements.

21. Simondon, *On the Mode of Existence of Technical Objects,* 91.

22. Ibid., 12.

23. Leroi-Gourhan, *L'homme et la matière,* 27.

24. Ibid.

25. Simondon, *On the Mode of Existence of Technical Objects,* 77.

26. Ibid., 83.

27. Goldfarb, "Root of SGML." Goldfarb is one of the three inventors of GML; there is also another meta-meaning for the term *GML*: *G* stands for Goldfarb, *M* and *L* for Mosher and Lorie.

28. Berners-Lee and Lawson, "Sir Tim Berners-Lee Talks to Mark Lawson."

29. Yott, "Introduction to XML," 214.

30. Berners-Lee, "Web Architecture from 50,000 Feet."

31. Quoted from Aristotle, *Metaphysics,* by Thomas, "Going into the Mould," 18.

32. Heidegger, *Basic Problems of Phenomenology,* 165–67.

33. Max Weber pointed this out decades ago. It was recently taken up by Richard Sennett, who argues for the return of craftsmanship as a remedy to the current situation of capitalistic development. See Sennett, *The Craftsman.*

34. Alexander, *Notes on the Synthesis of Form,* 15.

35. Simondon, *On the Mode of Existence of Technical Objects,* 62.

36. Ibid., 85.

37. Berners-Lee and Mendelsohn, "Rule of Least Power."

38. Berners-Lee and Connolly, "Hypertext Markup Language (HTML) Internet Draft."

39. Raggett et al., "A History of HTML."

40. Alesso and Smith, *Thinking on the Web,* 13.

41. W3C, "XHTML 1.0."

42. Shankland, "An Epitaph for the Web Standard, XHTML 2."

43. Pieters and van Kesteren, "HTML5 Differences from HTML4."

44. Berners-Lee, *Weaving the Web,* 225–26.

45. Berners-Lee et al., "Semantic Web."

46. Smith et al., "OWL Web Ontology Language Guide."

47. http://www.scripting.com/stories/2007/08/22/anatomyOfAFlickrPhotoItsMe.html. The picture on Flickr is http://www.flickr.com/photos/scriptingnews/1166257196/in/photostream/.

48. http://www.flickr.com/services/api/flickr.photos.getInfo.html.

49. Berners-Lee, *Weaving the Web,* 201.

2. Digital Objects and Ontologies

1. Simondon, *On the Mode of Existence of Technical Objects,* 40.

2. Quoted by Hennig, "What Is Formal Ontology?," 39, from Aristotle, *Metaphysics,* Γ1, 1003a21–2.

3. Searle, *Mystery of Consciousness,* 14.

4. According to Turing's 1950 paper, which appeared in *Mind,* if a judge engaging in natural language conversations with a machine and a human is unable to differentiate the machine from the human, then the machine passes the Turing test. See Turing, "Computing Machinery and Intelligence."

5. Searle et al., "Is the Brain a Digital Computer?," 30.

6. Quine, "On What There Is."

7. Ibid.

8. We have to distinguish a universal language and grammar here, for example, classification vocabularies belong to the semantic field and logic belongs to the syntactic field.

9. Kant and Pluhar, *Critique of Pure Reason,* A81, B107.

10. Foucault, *Order of Things.*

11. For a more detailed description, please read Barry Smith's longer draft of the article "Ontology"; the same illustration is cited by Michel Foucault in the introduction to *Order of Things.*

12. Borges, "Analytic Language of John Wilkins."

13. Quoted by Goody, *Domestication of the Savage Mind,* 23, from Durkheim and Mauss, *Primitive Classification,* 55.

14. Gruber, "Every Ontology Is a Treaty."

15. Ibid.

16. http://www.ontologyportal.org/index.html.

17. The following examples are taken from the report of Colomb, "Formal versus Material Ontologies."

18. http://ontolog.cim3.net/cgi-bin/wiki.pl?OpenOntologyRepository.

19. Guarino, "Formal Ontology in Information Systems."

20. Poli, "Descriptive, Formal, and Formalized Ontologies."

21. Hennig, "What Is Formal Ontology?," 43.

22. See Husserl, *Logical Investigations,* vol. 2, investigation VI, chapter 6.

23. Russell, *Husserl: A Guide for the Perplexed,* 30–35.

24. Hennig, "What Is Formal Ontology?," 54.

25. Smith and Welty, "Ontology—Towards a New Synthesis."

26. Smith and Mulligan, "Framework for Formal Ontology."

27. Third Logical Investigation. Smith, "An Essay in Formal Ontology."

28. Poli, "Descriptive, Formal, and Formalized Ontologies," 189. In *Formal and Transcendental Logic,* 86. Husserl admitted that the investigation of formal ontology in *LI* is limited.

29. Husserl, *Formal and Transcendental Logic,* 147.

30. Husserl and Koestenbaum, *Paris Lectures,* 14.

31. Husserl, *Formal and Transcendental Logic,* 83.

32. S. Bachelard, *A Study of Husserl's Formal and Transcendental Logic,* 40.

33. Crosson, *Formal Logic and Formal Ontology,* 263.

34. S. Bachelard, *A Study of Husserl's Formal and Transcendental Logic,* 111.

35. Husserl, *Formal and Transcendental Logic,* 106.

36. Ibid., 111.

37. S. Bachelard, *A Study of Husserl's Formal and Transcendental Logic,* 96.

38. Ibid., xliv, xxxix.

39. Gruber, "Every Ontology Is a Treaty."

40. Cantwell Smith, *On the Origin of Objects,* 9.

41. Ibid., 10.

42. Ibid., 15.

43. Ibid., 64.

44. In this perspective, Cantwell Smith displays some Heideggerian motifs, especially when he criticizes the subject and object separation, in contrast to which for him "the conclusion is actually very simple: the world, our world, is one." This is similar to what Heidegger calls being-in-the-world.

45. Ibid., 349.

46. Ibid., 350.

47. Ibid., 226.

48. It is on this point that Bernard Stiegler proposes that idealization can only exist when the product of ideation is exteriorized as technical object, which is also a passage from primary and secondary retention to tertiary retention.

49. Cantwell Smith, *On the Origin of Objects,* 233.

50. Husserl et al., *Phenomenology of Internal Time-Consciousness.*

51. Ibid., 57.

52. Cantwell Smith, *On the Origin of Objects,* 229. The phrase used by Husserl is "sensation of duration and duration of sensation"; see Husserl et al., *Phenomenology of Internal Time-Consciousness,* 30.

53. There are, however, two brief references to Husserl by name, ibid., 13 and 229.

54. Smith, "An Essay in Formal Ontology," 39–62.

55. Petitot, *Naturalizing Phenomenology.*

56. Husserl's "turn" is discussed in chapter 5 of this book concerning his three later works: *Experience and Judgement, Formal and Transcendental Logic,* and *The Crisis of European Science.*

57. Gilson, *L'être et l'essence,* 144.
58. Ibid., 130.
59. Ibid., 131.
60. Ibid., 146.
61. Ibid., 151.
62. Heidegger and Stanbaugh, *On Time and Being.* In his 1963 essay "My Way to Phenomenology," he announced that the "age of phenomenological philosophy seems to be over."
63. This doesn't mean that Husserl and Descartes share the same theory; we look at their differences in chapter 5.
64. Heidegger, *Being and Time,* section 93, 126.
65. Ibid., section 94, 127.
66. Ibid., section 95, 128.
67. Ibid., section 96, 130.
68. Dreyfus, *What Computers Can't Do.*
69. Courtine, "Suárez, Heidegger, and Contempory Metaphysics," 74.
70. Gilson, *L'être et l'essence,* 177.
71. Heidegger, *Die Geschichte des Seyns,* GA 69, 6.
72. See Malpas, *Heidegger's Topology,* 10–11. Malpas quoted Heidegger in *Time and Being*: "presence means: the constant abiding that approaches man, reaches him, is extended to him. . . . Not every presencing is necessarily the present. A curious matter. But we find such presencing, the approaching that reaches us, in the present, too. In the present, too, presencing is given."
73. In chapter 1, we cited Aristotle's demonstration of the relation between form and matter through the making of a statue.
74. McNeill, *Glance of the Eye,* 242–45.
75. Heidegger and Lovitt, *Question Concerning Technology,* 281.
76. Ibid., 282.
77. Heidegger, "Age of the World Picture," 133.
78. Simondon, *Imagination et invention,* 171.
79. Ibid.
80. Harman, *Tool-Being.*
81. The translation "matrix of relations" is proposed by Richardson, *Heidegger: Through Phenomenology to Thought,* 56.

3. The Space of Networks

1. Kant and Pluhar, *Critique of Pure Reason,* edition B, introduction, B5–B6.
2. Heidegger, *Being and Time,* 107; Heidegger, *Sein und Zeit,* 76.
3. Quoted by Dreyfus, *Being-in-the-World,* 21; from Heidegger, *Basic Problems of Phenomenology,* 21.

4. Heidegger, *Basic Problems of Phenomenology,* 313–14.
5. Heidegger, *Being and Time,* 106; Heidegger, *Sein und Zeit,* 75.
6. Heidegger, *Being and Time,* 105; Heidegger, *Sein und Zeit,* 75.
7. Heidegger, *Basic Problems of Phenomenology,* 185.
8. This is discussed in detail in chapter 5.
9. Heidegger, *Being and Time,* 110; Heidegger, *Sein und Zeit,* 80. Quoted by Dreyfus, *What Computers Still Can't Do,* 101.
10. Heidegger, *Being and Time,* 110; Heidegger, *Sein und Zeit,* 79.
11. Heidegger, *Being and Time,* 115; Heidegger, *Sein und Zeit,* 84.
12. Heidegger, *Being and Time,* 146; Heidegger, *Sein und Zeit,* 111.
13. Heidegger, *Being and Time,* 146; Heidegger, *Sein und Zeit,* 111.
14. Heidegger, *Being and Time,* 141; Heidegger, *Sein und Zeit,* 121.
15. Heidegger, *Being and Time,* 107–8.
16. Ibid., 108, emphasis added.
17. Heidegger, *History of the Concept of Time,* 274.
18. Ibid., 197.
19. Henry, *Material Phenomenology,* 17.
20. Bachelard, *A Study of Husserl's Formal and Transcendental Logic,* translator's preface, xiv.
21. Mall, *Experience and Reason,* 12.
22. Ibid., 19.
23. Henry, *Material Phenomenology,* 17.
24. Brower, *Medieval Theories of Relations.*
25. Quoted from Aristotle, *Categories,* 6a36–39, by Bains, *Primacy of Semiosis,* 17.
26. Brower, *Medieval Theories of Relations.*
27. Aristotle, *Metaphysics.* The three categories of relations are named following Decorte, "Relation and Substance," 5.
28. Aristotle, *Categories,* 2a13–2a18.
29. Decorte, "Relation and Substance."
30. Quoted by Bains, *Primacy of Semiosis,* 17, from Aristotle, *Categories,* 8a28–34.
31. Quoted by Brower, from Boethus, "In Categorias Aristotelis," in *Patrologiae Latinae Cursus Completus,* ed. J. P. Migne (Paris: Vivès, 1860), 64:238.
32. The article in the *Stanford Encyclopedia of Philosophy* by Brower has provided a nice overview of some of the arguments, but a few key thinkers are missing in this entry, notably Avicenna, Giles de Rome, and Henry of Ghent. The work of Jos Decorte gives another overview traversing these thinkers.
33. Decorte, "Relatio as Modus Essendi," 309.
34. Ibid., 332, quoted from Avicenne, "Liber de philosophia prima sive scientia divine," in *Avicenna Latinus* (Leuven-Leiden: Peters, 1977), 1:173, 18–174, 35.
35. Gilson, *L'être et l'essence,* 129.

36. Decorte, "Relatio as Modus Essendi," 318.
37. Ibid.
38. Brower, "Relations without Polyadic Properties."
39. Here I refer to the close relation between Being and language. For Heidegger, language is the house of Being.
40. See Mulligan, "Relations through Thick and Thin."
41. Ibid.
42. The term *substance fetishism,* or *Substanzfetischmus,* was proposed by Sloterdijk and Heinrichs in *Die Sonne und der Tod,* 137–39.
43. Gasché, *Of Minimal Things,* 3.
44. We will later see the similarity between Hume's atomism and Russell's logical atomism.
45. Hume, *A Treatise of Human Nature,* 25.
46. For Empiricism, synthetic judgment a priori is impossible because the synthetic is necessarily empirical. It must therefore be a posteriori, while Kant's *Critique of Pure Reason* aims to explain how synthetic judgment a priori is possible.
47. Deleuze, *Empiricism and Subjectivity.*
48. Bains, *Primacy of Semiosis,* 68.
49. Bains thinks that Hume did not discover relations to be ontological; they only become ontological after Deleuze's radicalization. However, Deleuze himself credits Hume with this discovery of ontological relations as something external to their terms. Also, as we have already demonstrated in our discussion of Husserl's radical interpretation and Hume's rejection of substance, it is clear that Hume had already developed a theory by which to understand all phenomenal objects in terms of relations. It also worth mentioning that for Hume, even the self is relational, hence a fiction. Because the self is fictional, Deleuze is able to relate subjectivity with empiricism, because the self is always a play of relations and beliefs. See ibid., chapter 2, 25–38.
50. Hume, *A Treatise of Human Nature,* 25.
51. Quoted by Murphy, *Hume and Husserl,* 26, from Hume, *A Treatise of Human Nature,* 25. Murphy discusses Husserl's two ways of understanding Hume's "distinction rationis." It is based on this that I have tried to reinterpret the passage in the treaties. Indeed, such an approach makes Hume's theory of relations much clearer.
52. Hume, *A Treatise of Human Nature,* 25.
53. Quoted from Husserl, *Logical Investigations,* vol. II/1, 197, by Murphy, *Hume and Husserl,* 70.
54. Ibid.
55. Ibid.
56. Ibid., 25.
57. Ibid.

58. These texts were written between 1893 and 1917; however, the book edited by Martin Heidegger was only published in 1928, one year after the release of *Sein und Zeit.*

59. Hume and Buckle, *An Enquiry Concerning Human Understanding and Other Writings.*

60. Quoted by Deleuze, *Empiricism and Subjectivity,* 96.

61. Hume, *A Treatise of Human Nature,* 23.

62. Ibid.

63. Quoted by Deleuze, *Empiricism and Subjectivity,* 99.

64. Hausman, "Hume's Theory of Relations," 260–62.

65. Deleuze, *Empiricism and Subjectivity,* 99.

66. Kant and Pluhar, *Critique of Pure Reason,* B128.

67. Ibid., B108.

68. Kant, *Critique of Judgement,* section 65. Kant's concept of the organic form has strongly influenced the German idealists, notably Schelling.

69. Ibid., section 64, 199.

70. Ibid.

71. Russell, *Principles of Mathematics.*

72. Dreyfus, *What Computers Can't Do,* 211.

73. Mugnai, *Leibniz' Theory of Relations,* 10.

74. Frémont, *Singularités,* 2001.

75. Mugnai, 19, quoted from Leibniz, "Notes to Temmik."

76. Widmaier, *Die Rolle der Chinesichen Schrift in Leibniz' Zeichentheorie,* 17.

77. Ibid., 76.

78. Ibid., 29, quoted from Leibniz, *Nouveaux Essaies.* "Car c'est par une admirable Oeconomie de la nature, que nous ne saurions avoir des pensées abstraites, qui n'ayant point besoin de quelque chose de sensible, quand ce ne seroit que des caracteres tels que sont les figures des lettres et les sons; . . . et si les traces sensibles n'estoient point requises, l'harmonie preétablie entre l'ame et le corps, . . . n'auroit point de lieu."

79. Russell, *Principles of Mathematics,* section 24. Russell said that Peirce and Schröder also spotted the importance of this subject, however, he then criticized them by saying that as they did not base their method on Giuseppe Peano (the Italian mathematician) but on the older Symbolic logic derived from Boole, their theory is too cumbrous and difficult to have any practical application.

80. See Husserl et al., *Experience and Judgement,* 221–22.

81. Russell, *Principles of Mathematics,* section 29.

82. Ibid.

83. Ibid., section 30. Russell in this chapter made several assumptions: (1) every relation has a converse; (2) the negation of a relation is a relation, and the logical product of a class of relations is a relation; (3) the relative product of two relations

must be a relation; (4) material implication is a relation; and (5) the relation of a term to a class to which it belongs is a relation.

84. Computer Science and Telecommunications Board (CSTB), *Funding a Revolution: Government Support for Computing Research* (Washington, D.C.: National Academy Press, 1999), 162.

85. McCool, "Rethinking the Semantic Web, Part I."

86. Mika, *Social Networks and the Semantic Web,* 56–58.

87. Ibid., 61.

88. Grolinger et al., "Data Management in Cloud Environments."

89. Dourish, "NoSQL."

90. This implies important political and social changes, which we are not able to explore here.

91. At the same time, we see the convergence between these two. As we saw in chapter 1, in the vision of the semantic web, the intelligent agent plays a very important role in decision making and making logical inferences.

92. Hume, *A Treatise of Human Nature,* 24.

93. See McGuinness and van Harmelen, "OWL Web Ontology Language," where they define "different from": an individual may be stated to be different from other individuals. For example, the individual Frank may be stated to be different from the individuals Deborah and Jim. Thus, if the individuals Frank and Deborah are both values for a property that is stated to be functional (thus the property has at most one value), then there is a contradiction. Explicitly stating that individuals are different can be important when using languages, such as OWL (and RDF), that do not assume that individuals have one and only one name. For example, with no additional information, a reasoner will not deduce Frank and Deborah as being referred to as distinct individuals.

94. Heidegger, *Being and Time,* 97, section 68.

95. Quoted by Malpas, *Heidegger's Topology,* 105, from Heidegger, GA2 *(Sein und Zeit),* H367, "daß diese Räumlichkeit existenzial nur durch die Zeitlichkeit möglich ist."

96. Heidegger, *Fundamental Concepts of Metaphysics,* 198; GA 29/30, 291.

97. This is very significant in Hubert Dreyfus's work on Heideggerian AI: several computer scientists are influenced by him, including Terry Winograd and Philip Agre.

98. Agamben, *The Open,* 40.

99. von Uexküll, "A Stroll through the World of Animals and Men," 31.

100. Bains, *Primacy of Semiosis,* 62.

101. Ibid., 81.

102. Ibid., 83.

103. Canguilhem, "The Living and Its Milieu."

104. Ibid., 13.

105. Ibid., 19.
106. Triclot, "Milieu Technique."
107. Leroi-Gourhan, *Milieu et technique,* 334.
108. Quoted by Triclot, "Milieu Technique," 24, from Leroi-Gourhan, *Milieu et technique,* 332.
109. Stiegler, *Technics and Time,* vol. 1.

4. The Time of Technical Systems

1. Dreyfus, *What Computers Can't Do,* 196.
2. Dreyfus, "Why Heideggerian AI Failed."
3. Dreyfus, *What Computers Still Can't Do,* 289.
4. Wilks, "Semantic Web," 42.
5. Dreyfus, "Why Heideggerian AI Failed."
6. Library scientist Tefko Saracevic borrowed the term "system of relevances" to characterize his study of information relevance; see Saracevic, "Relevance."
7. Schutz, *Reflections on the Problem of Relevance,* 91, 172.
8. Ibid., 84.
9. Ibid., 100.
10. Ibid., 72–74.
11. Ibid., 26. According to Schutz, the Latin word for *object* and the Greek word for *problem* have the same origin: "that which is thrown before me."
12. Ibid., 147, emphasis added.
13. I don't mean to reject the whole approach of intersubjectivity here. The following two chapters will go back to the question of intersubjectivity.
14. Simondon, *Imagination et invention,* 18–23.
15. Heidegger and Hofstadter, "The Thing," 164.
16. Ibid., 175.
17. Simondon, *Du mode d'existence des objets techniques,* 216.
18. Wagemans et al., "A Century of Gestalt Psychology in Visual Perception," 1172–217.
19. Simondon, *Du mode d'existence des objets techniques,* 232, emphasis added.
20. Ibid.
21. Simondon, *Imagination et Invention,* 142.
22. Heidegger and Hofstadter, "The Thing," 171.
23. Simondon, *Du mode d'existence des objets techniques,* 237.
24. Simondon, *Imagination et invention,* 139.
25. Simondon, *Du mode d'existence des objets techniques,* 303, emphasis added.
26. Tricol, "Milieu techniques."
27. Ellul, *Technological System,* 83.
28. Ibid., 82.

29. Ibid., 230.
30. Ibid., 234.
31. Gille, *Histoire des techniques,* 19.
32. Gille, "La notion de 'système technique,'" 8–18.
33. Cavallucci and Rousselo, "Evolution Hypothesis," 32.
34. Ellul, *Technological System,* 102.
35. Grier, "Relational Database and the Concept of the Information System," 9–17.
36. Ibid., 10.
37. Ibid., 16.
38. Ellul, *Techological System,* 111.
39. Heidegger, "The Thing," 174.
40. Simondon, *L'individuation à la lumière des notions de forme et d'information,* 90.
41. Heidegger, *Being and Time,* section 73, 431–32, emphasis added.
42. Ibid., 431.
43. The Latin sentence means "I don't die completely."
44. Agre, *Computation and Human Experience,* 96–102.
45. Ibid., 99.
46. Historically, a second is defined in terms of the rotation of the earth as 1/86,400 of a mean solar day, but then it was recognized that the earth doesn't have a regular rotating rate, so a "leap second" was added to compensate for the slowing rotation. Unless high precision is demanded, UTC can be regarded the same as GMT in terms of temporal indication.
47. This reflection is based on information from the permanent exhibition in the Greenwich Royal Observatory, London.
48. Hobbs and Pan, "Time Ontology in OWL."
49. Hobbs and Pan, "An Ontology of Time for the Semantic Web," 68.
50. Ibid., 69.
51. Sowa, *Knowledge Representation,* 114. This understanding of time goes all the way back to Zeno's paradoxes, which suggest that if time can be reduced infinitely into ever smaller instants, then it is impossible to account for movement or temporal change. But if, following Bergson, time can only be thought as duration, then the basis of the paradoxes is apparently invalid.
52. A widely used ontology of time in AI is defined by James Allen; Hobbs and Pan's paper is also based on Allen's ontology. These are the temporal relations specified in the ontology of James Allen.
53. See also David Hume's philosophical relations, with time as one of the categories of comparison, referring to now, after, before, etc.
54. Serres and Latour, *Conversations on Science, Culture, and Time,* 58.
55. Ibid.
56. Ibid., 60.

57. Prigogine, "Rediscovery of Time," originally prepared for the Isthmus Institute, presented to the American Academy of Religion, December 1983.

58. Simondon, "Limit of Human Progress," 229–36.

59. Heidegger and Krell, "End of Philosophy and the Task of Thinking," 383.

60. Ibid., 374.

61. Simondon, *Du mode d'existence des objets techniques,* 303.

62. Ibid., 302.

63. Simondon, "Limit of Human Progress," 232.

5. Logic and Object

1. Simondon, "Technical Mentality," 20.

2. Simondon, *Du mode d'existence des objets techniques,* 276.

3. We will look at the relation between interobjectivity and intersubjectivity again at the end of this chapter.

4. http://www.etymonline.com/index.php?term=traduce.

5. Lokhorst, "Descartes and the Pineal Gland."

6. http://www.its.bldrdoc.gov/fs-1037/dir-037/_5539.htm.

7. Hui, "Deduktion, Induktion und Transduktion."

8. Simondon, *L'individuation à la lumière des notions de forme et d'information,* 32–33.

9. Deleuze, *A Thousand Plateaus,* 367.

10. Ibid., 408.

11. Cocchiarella, "Logic and Ontology," 117.

12. Weigelt, "Relation between Logic and Ontology," 507–41.

13. Cocchiarella, "Logic and Ontology," 117.

14. Weigelt, "Relation between Logic and Ontology."

15. Cocchiarella, "Logic and Ontology," 117.

16. Munn, "What Is Ontology For?," 12. "The information stored in automated systems constitutes knowledge in the sense of beliefs which we have every reason to believe are true, but to which we will not adhere dogmatically should we obtain overruling reasons to believe otherwise."

17. The predecessor of OWL is DAML+OIL, which is based on the DL framework.

18. Smith, *Benefits of Realism,* 109. DL "fall squarely within the Fregean tradition—effectively, they are a family of computable fragments of FOL—and thus they, too, have some of the resources needed to deal with reasoning about instances."

19. Hayes, "Catching the Dreams."

20. For a detailed reading of the adaptation of syntax and semantics, please see Menzel, "Knowledge Representation."

21. Alesso and Smith, *Thinking on the Web,* 76.

22. Berners-Lee, "Semantic Web as a Language of Logic." In this note, Berners-Lee was discussing Frege's failure (Russell's paradox) and asking about the possibility of redefining validity: "When Frege tried second-order logic, I understand, Russell showed that his logic was inconsistent. But can we make a language which is consistent (you can't derive a contradiction from its axioms) and yet allows enough to for example: Model human trust in a realistic way Write down the mapping from XML to RDF logic to allow a theorem to be proved from the raw XML (and similarly define the XML syntax in logic to allow a theorem to be proved from the byte stream), and using it."

23. Davis, *Engines of Logic,* 52.

24. More exactly, the task is to prove that one can apply the rules of FOL to a system of axioms for the natural numbers, now known as Peano arithmetic.

25. Davis, *Engines of Logic,* 146–50.

26. Menzel, "Knowledge Representation," 269–95.

27. Witherspoon, "Logic and the Inexpressible in Frege and Heidegger," 94.

28. Quoted by Hill, *Word and Object in Frege, Husserl, and Russell,* 115.

29. Frege, "Concept and Object," 168–80.

30. Quoted by Davidson, *Truth and Predication,* 134, from Frege, "Concept and Object."

31. I use quotation marks for "complete" here because a digital object, or indeed any kind of object, is never complete, not even in itself.

32. Frege, "On Sense and Reference," 24–42.

33. Ibid., 25.

34. Davidson, *Truth and Predication,* 147.

35. Ibid., 133. Frege accepts the fact that the reference may not actually exist but contends that it must be real and objective. For example, consider this expression: "Odysseus deeply asleep was put to shore in Ithaca." Frege claims that "whether the name Odysseus has a reference is therefore immaterial to us, as long as we accept the poem as a work of art." When we talk about Odysseus as, on one hand, someone who may have existed at the time of Homer or, on the other hand, someone who only exists in Homer's epic, how can we be referring to the same Odysseus? How can we guarantee the identity of a proper name as such? This dilemma is further taken up by Bertrand Russell as part of a theory of acquaintance in his famous article "On Denoting."

36. Halpin, "Sense and Reference on the Web," 153–78.

37. Kripke, *Naming and Necessity,* 44.

38. Putnam, "Meaning of 'Meaning,'" 219.

39. Kripke, *Naming and Necessity,* 52.

40. Halpin, "Sense and Reference on the Web."

41. Monnin, "La ressource et les agencements fragiles du web."

42. Quoted by Mayergrazer, "Evidence, Truth, and Judgement," 175–97, from

Frege, *Nachgelassene Schriften,* ed. H. Hermes, F. Kambartel, and F. Kaulbach (Hamburg, Germany: Felix Meiner, 1983), 157.

43. Husserl et al., *Experience and Judgement,* section 50. The fundamental structure of Predication.

44. Tito, *Logic in the Husserlian Context,* 88.

45. Quoted by Mohanty in *Logic, Truth, and the Modalities,* 13, originally from Frege, *Nachgelassene Schriften,* 115.

46. Kolakowski, *Husserl and the Search for Certitude.*

47. Husserl states in *Formal and Transcendental Logic,* 211, that "experiential judgement—is nevertheless the original judgement."

48. Husserl, *Crisis of European Sciences,* 99.

49. Ibid., 97.

50. Husserl et al., *Experience and Judgement,* 16.

51. Davis, *Engines of Logic,* 89.

52. Husserl, *Crisis of European Sciences,* 44.

53. Ibid.

54. Husserl and Koestenbaum, *Paris Lectures,* 13.

55. Ibid., 22.

56. Husserl, *Experience and Judgement,* 203.

57. Husserl, *Ideas Pertaining to a Pure Phenomenology,* 212.

58. Husserl was a student of the psychologist and philosopher Franz Brentano, and the concept of intentionality is actually a legacy from Brentano. We may also note that Husserl and Willard, *Philosophy of Arithmetic,* has the subtitle *Psychological and Logical Investigations.*

59. Husserl, *Crisis of European Sciences,* 76.

60. Ibid., 107.

61. The most influential comparison has been made by Dagfinn Føllesdal, "Husserl und Frege, ein Beitrag zur Beleuchtung der Enstehung der phänomenologischen Philosophie," in *Mind, Meaning, and Mathematics: Essays on the Philosophical Views of Husserl and Frege,* ed. L. Haaparanta (Dordrecht: Kluwer, 1994).

62. Husserl, *Logical Investigations,* 2:292.

63. Husserl, *Crisis of European Sciences,* 96, section 25. "The naïveté of speaking about 'objectivity' without ever considering subjectivity as experience, knowing, and actually concretely accomplishing, the naïveté of the scientist of nature of the world in general, who is blind to the fact that all the truths he attains as objective truths and the objective world itself as substratum of his formulae (the everyday world of experience as well as the higher-level conceptual world of knowledge) are his own life-construct developed within himself—this naïveté is naturally no longer possible as soon as life becomes the point of focus."

64. Husserl, "Objectivity and the World of Experience," 343.

65. Husserl, *Crisis of European Sciences,* 139.

66. Husserl, "Objectivity and the World of Experience," 346.

67. Luhmann, *Art as a Social System,* 139. "Meaning serves as the medium not only of communication but also of consciousness. One must therefore conceive of the specificity of this medium in very general terms without assuming a psychic or social-system reference. The formal specificity of meaning, whose formative capacity qua medium we introduced earlier, manifests itself in phenomenological as well as in modal-theoretical analyses. Both types of analysis presuppose a temporal restriction of meaning, a time-related actualization of meaning in an instant of experience or of communication."

68. Luhmann, "Operational Closure and Open System," 1422, where he accuses phenomenology of being obsessed with the "internal darkness of a conscious system."

69. Husserl, "Origin of Geometry," 365.

70. Ibid.

71. Ibid., emphasis added.

72. We can also see a similar approach in Luhmann, when he proposes that the reduction of complexity is not a simplification but a means of resolving complexity with complexity.

73. On this question, Deleuze's notion of the "intensive quantity" joins Quine's slogan "to be is to be the value of a variable"; see Deleuze, *Difference and Repetition,* chapter 5, and Quine, "On What There Is."

74. Simondon, *Du mode d'existence des objets techniques,* 72.

75. In *Crisis of European Sciences,* Husserl uses "The Life-World as the Forgotten Meaning Foundation of Natural Science" as the title of section 9, part II.

76. Shirky, "Ontology Is Overrated."

77. For earlier experiments on tagging, please see Teil and Latour, "Hume Machine."

78. Quoted by Flynn, "Living Body as the Origin of Culture," 72.

79. Quoted by Flynn, ibid., 68.

80. Quoted by Flynn, ibid., 75, from Husserl, *Ideas II* (Hua IV, 333/345).

6. Logic and Time

1. Clark and Chalmers, "Extended Mind."

2. Nietzsche, *Die Fröhliche Wissenschaft,* section 124: "Wir haben das Land verlassen und sind zu Schiff gegangen! Wir haben die Brücke hinter uns—mehr noch, wir haben das Land hinter uns abgebrochen! . . . Aber es Kommen Stunden, wo du erkennen wirst, das sehr unendlich ist und dass es nichts Furchtbareres gibt als Unendlichkeit." http://www.textlog.de/nietzsche-wissen.html.

3. Caputo, "Language, Logic, and Time."

4. Vukićević, *Logik und Zeit,* 4. "*Die Frage nach der Logik ist die Frage der Vorlesungen,* vom 25–26 bis zum SS1928" (WS25/26, SS1927 und WS27/28), but it

seems here that the author ignored the very important SS1925 *Vorlesung,* "History of the Concept of Time."

5. Heidegger, *Gesamtausgabe,* 1:20. "G. Freges logisch-mathematische Forschungen sind meines Erachtens in ihrer wahren Bedeutung noch nicht gewürdigt, geschweige denn ausgeschöpft. Was er in seinen Arbeiten über 'Sinn und Bedeutung,' über 'Begriff und Gegenstand' niedergelegt hat, darf keine Philosophie der Mathematik übersehen, es ist aber auch im gleichen Masse wertvoll für eine allgemeine Theorie des Begriffs."

6. Caputo, "Language, Logic, and Time," 149.

7. Heidegger, "My Way to Phenomenology," in *Time and Being,* 76. "However, my repeated beginning also remained unsatisfactory, because I couldn't get over a main difficulty. It concerned the simple question how thinking's manner of procedure which called itself 'phenomenology' was to be carried out."

8. Mohanty, *Logic, Truth, and the Modalities,* 83.

9. Half of the *Grammatical Speculation* was written by Thomas of Erfurt rather than Duns Scotus. Heidegger was aware of this, but he was satisfied with the work regardless; in a reply to a letter from Martin Grabmann (January 7, 1917), he stated, "Perhaps it is interesting for you to hear that the work has been illuminating for Husserl to such an extent that I can be satisfied. Also Rickert now looks upon the scholastic with different eyes." Kusch, *Language as Calculus,* 143.

10. It was credited by Husserl as such in *Formal and Transcendental Logic,* 49n2.

11. Heidegger, *History of the Concept of Time,* section 6, 56.

12. Heidegger writes, "The Greeks did not have a word for language"; see *Being and Time,* 204.

13. Ibid., 47.

14. Heidegger, *History of the Concept of Time,* 264.

15. Heidegger, "Logos," 211.

16. Fay, *Heidegger: The Critique of Logic,* 32.

17. Ibid., 28.

18. Quoted by Heidegger and Boss, *Zollikon Seminars,* 91, from N. Wiener, *Mensch und Menshmaschine: Kybernetik und Gesellschaft* (Frankfurt am Main, Germany: Alfred Metzner, 1964).

19. Ibid.

20. Ibid.

21. Heidegger uses three German words that share the same root of *Sorge*: *Sorge* (care), *Besorgen* (concern), and *Fürsorge* (solicitude). *Besorgen* refers to the mode of ready-to-hand, and *Fürsorge* is related to being with others. *Sorge,* care, bears a preontological significance in the fable Heidegger quotes, in which man is named after care.

22. Dastur, *Telling Time,* 40.

23. Ibid., 51.

24. Heidegger proposes the distinction between *Metaphysica Specialis* and *Metaphysica Generalis*; the former refers to theology, cosmology, and psychology, the latter to ontology, which we can understand as an attempt to recover the question of being after definition of the subject of metaphysics in the medieval time after Avicenna and Thomas Aquinas. For Heidegger, Kant's task is to lay the foundation for *Metaphysica Generalis,* for ontological knowledge, in the name of transcendental philosophy.

25. Dastur, *Telling Time,* 100n18.

26. Heidegger and Taft, *Kant and the Problem of Metaphysics,* section 31.

27. Ibid.

28. Ibid., 118.

29. Ibid., section 32, 123, emphasis added.

30. Dastur, "Time and Subjectivity."

31. Heidegger and Taft, *Kant and the Problem of Metaphysics,* section 22, 73; Kant and Pluhar, *Critique of Pure Reason,* A142, B182.

32. Heidegger and Taft, *Kant and the Problem of Metaphysics,* 74.

33. Ibid., section 34, 137.

34. Makkreel, *Imagination and Interpretation in Kant,* 22–25.

35. The German word *Bild,* which means "image," disappears in these translations. This will contrast with our development of temporal synthesis later in this chapter.

36. Hoy, *Time of Our Lives,* 18.

37. Heidegger, *History of the Concept of Time,* 261.

38. Fay, *Heidegger: The Critique of Logic,* 78n95, quoted from Heidegger, *Die Frage nach dem Ding,* in GA 41, 137: "Die Logik kann nicht die Grundwissenschaft der Metaphysik sein."

39. Heidegger, *Being and Time,* section 64, 367.

40. Fay, *Heidegger: The Critique of Logic,* 78.

41. Quoted by Dastur, "Time and Subjectivity," from Heidegger and Taft, *Kant and the Problem of Metaphysics,* section 9, 30: "The pure representing which takes things in stride must give itself something capable of being represented. Pure intuition, therefore, must in a certain sense be creative."

42. Heidegger and Taft, *Kant and the Problem of Metaphysics,* section 29, 104.

43. Ibid., section 45, 170.

44. Ibid., 171.

45. Tito, *Logic in the Husserlian Context,* xxxiii.

46. Roberts, *Logic of Reflection,* 63.

47. Dupuy, *Mechanization of the Mind,* 93. Dupuy showed that even in McCullough's dynamic systems theory, he was trying to demonstrate the mapping between the neurons and logical connectives (and, or, not, and so on).

48. Varela et al., *Embodied Mind,* 47.

49. Stiegler, *Technics and Time,* 3:56.

50. Ibid.

51. Ibid., 140.

52. Ong, *Orality and Literacy,* 84.

53. Kowalski, "Early Years of Logic Programming," 38–43.

54. See chapter 3 in the classic study of algorithms, Cormen, *Introduction to Algorithms.*

55. Examples are available at http://www.nist.gov/dads/HTML/recursion.html.

56. Hofstadter, *Gödel, Escher, Bach,* 131.

57. For computer science students, recursion is the hardest part of algorithms.

58. Quoted by Stiegler, *Technics and Time,* 2:176.

59. Varela and Maturana defined the structural coupling as a phylogenetic process: "As long as a unity does not enter into a destructive interaction with its environment, we as observers will necessarily see between the structure of the environment and that of the unity a compatibility or congruence. As long as this compatibility exists, environment and unity act as mutual sources of perturbation, triggering changes of state. We have called this ongoing process 'structural coupling.'" See Maturana and Varela, *Tree of Knowledge,* 99.

60. Maturana was critical of formalism, especially mathematical formalism as the understanding of system: "A mathematical formalism is a conceptual and operational system that reveals the relational coherences of the space that it defines. It is because of this that one can use mathematical formalisms to compute changes of states in systems whose operational coherences appear isomorphic to the relational coherences that they specify. But mathematical formalisms do not by themselves create an understanding of the phenomena that an observer helps to explain through them. In this same context one can say that biological phenomena occur on the edge of chaos, because one can use some mathematical formalisms as evocative metaphors. However, to say that does not say what kind of systems living systems are, nor how they exist in the new domains that arise as their operation as totalities begins to be conserved in the flow of their structural coupling with the medium that arises with them. Living systems, as do systems in general, occur in their happening as actual discrete singular entities, not in the formalisms that an observer may use to think about them." Maturana, "Autopoiesis, Structural Coupling, and Cognition."

61. Dreyfus, "Why Heideggerian AI Failed": "Clark's and Chalmers's examples of extended minds manipulating representations such as notes and pictures are clearly cases of temporal austerity—no rates and rhythms are involve," and later, "[Michael] Wheeler's cognitivist misreading of Heidegger leads him to overestimate the importance of Andy Clark's and David Chalmers's attempt to free us from the Cartesian idea that the mind is essentially inner by pointing out

that in thinking we sometimes make use of external artifacts like pencil, paper, and computers. Unfortunately, this argument for the extended mind preserves the Cartesian assumption that our basic way of relating to the world is by using propositional representations such as beliefs and memories whether they are in the mind or in notebooks in the world."

62. Adams, *An Early History of Recursive Functions.*

63. Ibid., 22.

64. Shagrir, "Gödel on Turing on Computability."

65. Ibid.

66. Adams, *An Early History of Recursive Functions,* 58.

67. This term was proposed by Professor Scott Lash during a discussion in summer 2010.

68. Heidegger and Sadler, *Essence of Truth,* 212.

69. The readers may find this reading comparable to Whitehead's system; see Whitehead, *Adventure of Ideas,* esp. chapter 11, "Subjects and Objects."

70. Guignon, *Heidegger and the Problem of Knowledge,* 88–89.

71. Licklider, "Man–Computer Symbiosis," 4.

72. Deleuze, *Difference and Repetition,* 90.

73. Ibid., 86.

74. Ibid., 94.

75. Ibid., 90.

76. Klossowski, "Oubli et anamnèse dans l'expérience vécue de l'éternel retour du Même."

77. Ibid., 240.

78. Deleuze, *Difference and Repetition,* 74.

79. Heidegger and Boss, *Zollikon Seminars,* 58.

80. Simondon, *Du mode d'existence des objets techniques,* 72–73.

81. Ibid., 72.

82. For a more detailed description, please see Hui and Halpin, "Collective Individuation."

83. Moreno, *Who Shall Survive?,* 95.

84. Wasserman and Faust, *Social Network Analysis.*

85. https://developers.facebook.com/docs/reference/api/.

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