AUTOMATED PATTERNS OF CULTURE

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"But in heaven", I said, "perhaps, a pattern is laid up for the man who wants to see and found [it][1] within himself"

Socrates to Glaucon

Plato, *Republic*, Book IX, 592b

[1] Plato., and Bloom, A. (1968, p. 275, with modification in brackets).

To my father, who, opened the doors of his library for me since I was a child

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INTRODUCTION

This study, granted by the Deutscher Akademischer Austauschdienst (DAAD), is the product of three and a half years of research on the extent of machine learning (ML) in culture. It is also worth noting that this study is, at the same time, the product of a prolonged period of isolation during the pandemic outbreak, the time when the world became fully virtual.

In this section, I propose a brief propaedeutic guide to the contents of this work, whose narrative voice, as the reader will notice from the very first chapter onwards, will be shifted to the voice of the plural narrator. Such a voice portrays an inherited dialogue of diverse thoughts shaping the ideas behind these lines. Still, rather than a lengthy work of quotations combined with exhaustive encyclopedism, in a different manner and without losing academic rigour, this work aims to provide a theoretical proposal. With this aim, the kernel of this work is bringing together *culture* and *machine learning* under a common unit of analysis which is central to the nature of both, that is, the concept of *pattern*.

As it is already known, at the dawn of the 21st century, machine learning constitutes a whole new chapter not only for most sectors of all possible industries, also including education, but even more so, for all psychosocial processes, namely, for culture in its broadest sense. We are explicitly exposed to a new mode of production, reproduction, distribution, conservation, and transformation of the *patterns of culture*. We will extend on this in the next section. To put it in simple terms, the patterns of culture are the ways of *making sense* of the models of the world. From this view, culture is the mapping of patterns from which the human had made sense of its experience since its very inception. That is to say, the patterns of culture are the patterns that shape the behavior and customs of individuals. As early as 1934, Benedict Ruth, the author of *Patterns of Culture*, wrote:

> The life history of the individual is first and foremost an accommodation to the patterns and standards traditionally handed down in his community. From the moment of his birth the customs into which he is born shape his experience and behaviour (1960, p. 18).

Machine learning provokes culture radically. We are no longer entirely governing the patterns of culture and experience as previously accommodated by tradition and customs. Contemporary algorithms automate cultural traits that predict our behaviors, emotions, personal and aesthetic tastes, re-arrange our environment, relationships, and our attention while placing our patterns of behavior in similar clusters as other individuals by offering similar content as they. Culture is algorithmically rearranged by how alike patterns of individuals are. To automate the patterns of culture implies, above all else, to *control and manage attention*, and therefore, *behavior*. Reality is mostly composed of the patterns that, *en son fond*, one is (culturally) conditioned and accustomed to perceive. Therefore, to automate this process involves algorithmically offering certain patterns in order to statistically predict the next set of patterns. To select and to offer certain patterns to individuals does not merely imply the organization of the virtual environment, it implies a *force majeure*: to have access to the patterns of large masses of individuals in order to rearrange their attention and behavior as well. A conquer upon the patterns of culture is a conquer upon reality *in toto*. Today's *kubernetes* (from which *cybernetics* etymologically derives) *does not govern the ship but the entire sea of deep data*. The many mathematical methods and computational techniques constituting machine learning find the underlying structures in vast databases while shaping a phase-shift in culture.

We are heading towards an *automated pattern-based culture* and this is the heart of my hypothesis to be expanded throughout the work. This event has been largely unnoticed in all AI literature: *culture is the field where artificial intelligence plays its most important battle* because it is the field where the patterns that shape reality are algorithmically arranged, reproduced, and virally spread. This claim requires an entire analysis of the AI corpus ranging from the technical to the theoretical domains, which again, does not aim to be encyclopedic, but instead, to serve as a guide.

In order to build the groundwork for this work, I have decided, since the beginning of this research, to use Gilbert Simondon's (1924-1989) methodology based on his foundational formula for evolution: the genetic ontology or ontogenesis (*individuation*) as well as his general framework on technical objects and culture. The first part (i.e., all of Chapter III) introduces and discusses many of Simondon's concepts. Still, I do not aim to thoroughly analyze Simondon's literature, a great deal has already been said and written about it. Instead, I had tackled an entire reading of his works in order to turn it into a tool for this project. All Simondon's works are cited through abbreviations which are clarified in the bibliography section (see, List of Abbreviations of Simondon's works). The references to Simondon's elementary concepts in Chapter III ensures that the proposal towards the concept of *desindividuation* (to be analyzed) does not become isolated from the general context of this work. Despite the difficulty of Simondon's philosophy, the echo of his thoughts on technics, as Barthélémy (2015) accurately notes, is more illuminating today than it was in his time. Simondon is the last universal philosopher on earth and he is a philosopher of technics. This speaks volumes. The French philosopher is the one who saw philosophical value in the functioning of machines. This is why, it is precisely the one *with whom*, and above all, *against whom*, I have considered more pertinent to design the arguments to be presented along the work.

In order to do so, I have captured *three different levels of evolution of patterns* by way of an architectural cohesion, upon which, each part shall support the other. First, the pattern from its *ontological axiom*: patterns in-form (give form) to reality (Part I), this section offers a primordial basis on its dynamic nature and its potentiality to *give form* to perceptible reality. In this vein, Simondon's analysis on individuation and information become convenient. Second, from its *technological axiom*: patterns can be computationally automated (Part II), here the aim is to clarify the fundamental basis of ML functioning particularly in the light of the dynamics behind its mathematics. And third, the pattern is analyzed through its *cultural-political axiom*: culture is in-formed by computationally automated patterns (Part III), this is mainly where our hypothesis is undertaken, again: *we are heading, through machine learning, towards an automated pattern-based culture*.

The initial section, the Prolegomenon, introduces: the method, the object of analysis, the problems of this work, and the state of the art within the field. That very section intends to offer a well-formed picture of the goals while, at the same time, aims to establish a brief general critique on the contemporary posthuman and transhuman agenda where artificial intelligence (AI) has been placed in the spotlight. Focusing on the former point, the goals of this work also entail the reasons for the *shift beyond Simondon's concept of individuation*, namely, a formulation and critique to the progressively growing *des-individuation* process (Sect., Part III, Chapter VII, § 2.).

The automation of the patterns of culture is the automation of models in order to make sense of experience. Where attention is driven, is where one is able to perceptually recognize patterns in order to turn them into models, for example, of behavior and consumption. In our times, attention is algorithmically re-arranged and mediated. Yet, as useful as these models might be, however, they contain the trap of des-individuation: the tendency towards homogenization, towards uni-*form*ization, con-*form*ity, generality, gregarious tendencies, towards the *horror* of the statistical average. Such analysis has become more urgent than ever.

The second chapter, within the Prolegomenon, constitutes the very opening of our theoretical proposal. It begins with ancestrality (the patterns found in nature), followed by history (the patterns created, stored, and mediated by humans and machines), and ends with hyperhistory (the patterns created, stored, and mediated by machine-to-machine relations). The former concept, *ancestrality*, is inspired by Quentin Meillassoux studies, the last one, *hyperhistory*, by Luciano Floridi studies, although neither of both philosophers worked on the concept of pattern specifically. This is my own adaptation of their concepts. This project aims to turn essentially a reflective vision of AI, or at least a possible narrative, a pattern-based view of reality. The stage of hyperhistory, where ML processes succeed, is retrieved again, not only in that section but recursively along the whole work.

The first part, as I wrote above, introduces the thesis of Simondon, fundamentally, on the concept of individuation and information, and how these are bound to each other in the process of evolution of technical objects. This introduction on Simondon's concepts is significant because it gives place to, later, deeply explore the concepts of *form* and *information* throughout his literature including substantialist metaphysics, archetypal forms, and Gestalt theory. According to Simondon: "Philosophical thought will not be able to grasp the sense of coupling between man and machine unless it manages to elucidate the true relation that exists between form and information" (MEOT, 150). After this conceptual review, I intend to draw the limits on Simondon's concept of information where the place occupied by mathematics is based on his critique on the quantitative and probabilistic view of information mostly coming from the theory of information and statistical mechanics. Though, more than a critique, it aims to consider Simondon's understanding of individuation in order to move it towards the concept of desindividuation as developed in Part III.

Afterwards, in the section called, *Crystal-based technology*, from Part I, Simondon's key example of the process of crystallization as a *transductive* one becomes useful to consider the extent of transductive processes in the contemporary technological domain. Transduction not only becomes a kernel in the simondonian studies on contemporary technology, but also, in psychosocial processes as can be noticed in the section called *Techno-genesis.* The final section of Part I, entails two subsections one entitled: *The concept of pattern in Simondon* and another one called, *In-forming reality through patterns.* The first one introduces an unseen aspect in Simondon's works, the concept of «*pattern*» which, nonetheless, appears repeatedly along many of them, such as: *Individuation in light of notions of form and information* (1958), *Cours sur l'instinct* (1964), *Perception and Modulation* (1968), and *Imagination et Invention* (1965-1966). The second one is a brief and general description of how human as well as machines give-form to reality by means of *patterns* at different levels: the electro-signal processing level (physical magnitude), at the perceptive-sensory level (neuronal arrangement), at the abstract-operative level (genetic stages), at the linguistic level (sequence prediction), at psychosocial phase (sub-symbolic level).

Moving already to the second part (Part II), based on the technological axiom, I attempt to describe in an appealing manner the process of automation performed by machine learning. Appealing does not imply to fulfill it with cases and examples as we find mostly in introductory books of machine learning or artificial intelligence, it is rather an effort to build a narrative, to search for its philosophical value. This leads to the understanding, from the very beginning, of the problem of compressing data in order to form a model, which later highlights the methodological problems in ML itself. At the mid-point of Part II, I mention, in a quite simplified and general manner, something which is almost never treated in the humanist literature on ML and which is precisely the most important aspect of ML algorithms: the role of mathematics behind it. Machine learning is applied mathematics, to exceed in simplification. In that section, I focus on the concept of *space* as that which occupies a key role in the mathematics of ML. With this aim, the concept of dimensionality reduction is explored in the section called: *The mathematics behind the pattern* and it is deepened in the following one: *The mathematical pattern in space.* These sections do not demand mathematical background from the reader, on the contrary, as I elaborated from the beginning, the intention is to build a narrative while serving as a guide. In cases where mathematical formulas appear, these contain in square brackets the information to what part of the automation process they correspond, for example: grouping, distributing, and projecting data, all of which is explained subsequently. Space and patterns work together. It is no longer enough to understand the world encompassed by technologies, it is necessary to see the world spatialized by the technologies themselves.

The last subsection of Chapter V aims to explore the concept of *black box* in ML while retrieving its origins, debating its contemporary problems in the face of deep learning neural networks and also pointing to the stigmata of "the unknown" branded upon it. The final chapter of Part II constitutes a backwards to Simondon in order to shortly analyze the evolutionary cycles of the technical object according to three phases: craft and agricultural production, industrial and manufacturing production, and the current, post-industrial or hyperindustrial production. The final subsection, closing the entire second part, shall bridge the problems posed by an automated pattern-based culture, that is: the reproduction of models that simulate, imitate, distort, and copy reality along with Simondon's reading. I have named it: *The enterprise of reproducing reality,* which leads to the most critical problem posed by AI systems: *the problem* *of the indistinction between reality and simulacrum* while opening the path to the cultural problems to be treated in Part III.

The latter, Part III, contains the very heart of this work: the automated patterns of culture. Firstly, I inaugurate it with a historical description to grasp culture and its object (i.e., its sense (*Sinn*)) from its pre-modern cosmovision whose patterns were harmonized in a divine and cosmological way, passing through its modern conception whose patterns were guided by rational and empirical processes driven by new techniques and methodologies, and finally landing in the concept of culture and its automated patterns from the contemporary, hyperhistorical stage. For the latter, I approach the problem by observing how the objects of culture are no longer associated with the sacred, nor with truth-seeking processes by means of reason, but they become a manipulation of signs (Baudrillard (1993); Naomi Klein (2002 [c. 2000]) characterized by personalization, aestheticization, and differentiation at mass-consumption scale. In this scenario, there is a disruption with patterns bound by tradition because there is a new way of producing patterns aided by new technologies. Culture no longer produces patterns mirroring the sacred, nor the truth-based systems. In the third stage, cultural objects are oriented to the consumption of signs, of abstractions (e.g., Happiness, Growth, Abundance). In hyperhistory, we consume abstractions. This accounts for the exploration of machine learning technology and its profiling techniques (*user profiling*) able to access behavioral insights, that is to say, to access the patterns of culture. Given the limitations of Simondon conceptual scope (because of his historical context not including contemporary ML technologies), the third part is majorly guided through the one who drove Simondon to the next level: Bernard Stiegler (1952- 2020). The symbolic force of culture in the consumer society expresses the highest level of spiritual misery as forged by Stiegler (2013) whose emerging patterns become the task of our concern.

In the subsection called: *The behavioral orchestration behind artificial intelligence: technologies of the unconscious,* I introduce the concept of *technologies of the unconscious* to grasp the contemporary problem of how automation is able to degrade the role of consciousness, of attention, of pattern creation, namely, degrading the power of in-forming one's own reality. This massive loss of consciousness is a welcoming into *psychopolitics*, a concept initially introduced by Byung-Chul Han and also addressed, in a different manner, by Stiegler in terms of *psychotechnologies*. In this vein, along the following sections, I organize and bridge this problem by extending the deep mechanism of the "technologies of the unconscious": automated algorithms have access to our behavior-patterns (which are primarily emotionally rooted) this implies their access not to any rational-based behavior, but on the contrary, to the collective unconscious which is a purely automated state. *Artificial intelligence is a technology of the unconscious* more than of rational well-guided processes. It should remain clear that this theoretical propousal is not constructed as an anti-AI narrative, rather the opposite. It aims to be at the service of its best development which can only be mastered by paying attention to its flaws.

AI, by means of its latest chapter, machine learning, is bringing us closer to an increasingly archetypal culture, a pattern-based culture. But this is not the problem. The problem lies in the increasingly automatic response of individuals, in the loss of conscious attention to the patterns presented and how they manage to generate a greater uniformity and similarity, a greater loss of individuation between cultural traits. The following sections deepens the concept of des-individuation from the point of view of Simondon, Stiegler, and finally, my own: *Des-individuation as a political-cultural tool*. All arguments are thoroughly connected and land on the last chapter of this project: *Culture as the meta-pattern.* Culture, following Simondon's ambition on it, essentially has a unifying and regulative force, and in my terms, it takes the role of the *metapattern*. Culture as the metapattern represents the repository of all possible cultural traits, of all forces governing human's life, it has an archetypal force. Here I introduce various cultural debates opposing the concept of *patterns* (as a static and stable domain) to the concept of *dynamic relations* while attempting to dissolve them.

Patterns, grasped from the latest *psychotechnologies*, such as machine learning, no longer merely statistically arranging but having access to our psychic and cultural patterns while modifying them (in-forming them) have but a dynamic way of transforming, they are equivalent to what Simondon called "genetic archetypes", not purely static ones. This is also deepened in the *Appendix* section*: AI Metaphysics.* AI is a civilizational project, it stores and automates the preservation and the transformation of the patterns of culture while *we*, unsteadily, aim to make sense of them. We shall be aware more than ever before of the patterns algorithmically mediated in virtual environments, those shaping our decisions and behaviors, our view of reality itself.

PROLEGOMENON

On the state of the art, problems, and method

Anyone who fits things into one coherent pattern
will know what the world is like

Isaiah Berlin, Lecture on romanticism

This work is based upon three axioms:

1. *Ontological axiom*: Patterns in-form (give form) to reality (Part I)
2. *Technological axiom*: Patterns can be computationally automated (Part II)
3. *Cultural-political axiom*: Culture is in-formed by computationally automated patterns (Part III)

CHAPTER I

Automated Patterns of Culture

§1. The rise of an automated pattern-based culture

The "patterns of culture" used to be the human ways of giving meaning and sense to the world. During this century, the underlying patterns of individual and collective behavior are seen in a new light by means of automated mathematical models. A new era has begun, the patterns of culture are no longer human but algorithmic ways of *in-form*ing (giving form) to the world.

The generally well-accepted assumption that different "cultural features" (conventions, values, attention, desires, beliefs, and others) might "follow the most diverse patterns" and therefore, they can not lead to "generalizations" (as Franz Boas wrote when introducing Ruth Benedict's *Patterns of culture*, 1960 [c. 1934], p. xiv) continues being challenged and transformed by the last chapter in artificial intelligence, the new methodological approaches in computation and statistics roughly recognized as "machine learning".

The automation of *cultural features*[1] shall not be reduced to the prediction of human desires, rather, it predicts what Lautreamont poetically called: the mathematical soul. The pattern revealed by the data is an expression of *numerical values* reorganized through mathematical models whose variables are algorithmically operated. Such rearrangement of features (which are but numerical values) in terms of automated-based patterns are not humanly but computationally recognizable. In other words, we can no longer identify patterns of behavior except through data, which are numerical values, that have been computationally processed and rearranged.

The last universal philosopher, pioneer of the metaphysics of the becoming in the machine, Gilbert Simondon (1924-1989), wrote for our century that both, *technology* and the *sacred* are dimensions of unification and ecumenism that *Culture* shall bring together for it to become a *technical culture* with humans and machines progressively in-forming, giving form

[1] For an extended description of what cultural features are in the context of machine learning: Sect. Part III, Chapter XVII, 1.1.: *The behavioral orchestration behind artificial intelligence.*

to each other. The French author did not hide his *universal orientation* enabled by cybernetics (EC, 181) and, in order to achieve this, he reformulated the very concept of information itself. For Simondon, all definitions provided by 20th century cybernetics were narrow, mostly, because of their simplistic notion of information in quantitative terms. Therefore, he even rejected the definition of cybernetics as a quantitative study, as a supposedly objective positivist paradigm, and as operations of the conversion of signal into message given the background noise. Simultaneously, he distanced himself from the notion of information as an expressly teleological mechanism within the context of a determined input-output reaction scheme as well as from the view of information as a transmission scheme like that of neural activity. For Simondon, information[2] implied the "transformative operation of one structure into another structure" (EC, 182, own translation), namely, the change of one form into another, by the very functioning of the system. That is to say, in-formation, as operation of becoming or coming-to-being, does not only consist in providing structure but also in allowing its potential transformations (*devenir*) (Sect., Part I). To the narrow vision, Simondon opposed a universalist one. For the latter, he encompassed even more than the concept of cybernetics itself, he called it: *allagmatique*, the theory of operations, of conversions (ILFI, 110; EC, 184) (Sect., Part I).

Simondon's metaphysical framework on technology has prepared the fundamental and vital ground to think on the essence, evolution, and transformation of contemporary automated technology itself. His metaphysics does not begin from immovable or substantialist metaphysical postulates about *being* from which to infer a state of the world. He developed his work in terms of a genetic essence (ontogenesis), in terms of a becoming (*devenir*) of being: the process of *individuation* (Sect., Part I, Chapter III, §1.). By conceiving being not as a defined state but as an unfinished and unresolved process, he reached a forward-looking perspective on technology in general: "Cybernetics is the philosophical consciousness of a spontaneous problem whose terrain is a universal technology, cybernetics and philosophy" (CPH, 40, own translation). Cybernetics became, for Simondon, the paradigmatic method of what we can recognize as process metaphysics[3] or in terms of Simondon himself, ontogenetic processes.

[2] A detailed study of the notion of information in Simondon is extended in: Sect., Part I. Chapter III, §1., especially, in 1.1. and 1.3: *Introducing process metaphysics into the machine* and *The limitations of Simondon's notion of information.*

[3] The expression *process metaphysics* has been widely active in American studies ranging from Pre-socratic thinkers, such as Heraclitus, to Whitehead and beyond: "Process metaphysics as a general line of approach holds that physical existence is at bottom procesual; that processes rather than things best represent the phenomena that we encounter in the natural world about us" (Rescher, 1996, p. 2).

Only since Simondon, the machine, by means of the concept of information, inhabits the house of *becoming*. Its very essence meets the appropriate conditions for a cultural and philosophical analysis thus leaving room for further analysis and critics with respect to our contemporary information technologies.

Computationally automated patterns continue to cultivate and prepare the cultural soil by in-forming, de-forming, uni-forming, but also trans-forming our psycho-collective behavior and experiences. We refer to (big and small) patterns that are numerically based and technologically automated and which exhaust any meaning (*Sinn*) (Sect., Part III, Chapter VII, § 2., 2.3). But even of more interest here it is the claim that a culture of automated patterns invert the process of individuation as initially proposed by Simondon[4] [5]. An automated pattern-based culture tends to *des-individuation* (Sect., Part III, Chapter VII, § 2.).

This theoretical proposal, motivated by Simondon's analysis of technology and its genetic metaphysics performs a turn beyond Simondon[6]. A process of desindividuation shifts actualization in the opposite direction: not towards differentiation but towards a tendency of structuring and unification of forms, viz., towards the proper exigencies of similarity. An ontological, technological, political and cultural tendency towards a pattern-based culture is a scheme of differentiated homogeneities and not of differentiated processes as indicated by the first sense of individuation (Sect., Part III, § 3, 3.1.).

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[4] It is important not to infer the conceptual error between what we call "des-individuation" and the concept of "dis-individuation" employed by Simondon, whose specific use refers to the bio-psychic living. Regarding the latter, see the concept defined by: Barthélémy, J.H. (2012). A detailed description and differentiation between *dés-individualisation,* dis-individuation, and des-individuation is offered in: Sect., Part III, § 2., 2.1., 2.2., and § 3.: *Dés-individualisation, dis-individuation, and des-individuation, Dés-individualisation in Simondon Dis-individuation as psycho-technology,* and *Des-individuation as a political-cultural tool.*

[5] For a clear difference between *individuation* and *individualization*: Sect., Part I., Chapter III, §1. *Simondon's conceptual introduction,* especially see, footnote 1.

[6] The techniques of automation whose mathematical (heavily statistical) procedures move from the particular (data) to the general (model) are *neither* to be regarded in Simondon's lexicon to a "technical object" nor "technical individuals". In other words, it is no longer possible to strictly translate our machines in Simondon's terms. This is due to the nature of our unit of analysis (mathematical automation/machine learning) which does not take its source from the structures of the living and the organic (the epigenetic-based phenomena), as Simondon and Deleuze's studies did. The individuation of living organisms is always governed from the pre-individual or virtual processes towards its never-ending actualization. Rather, in a reversal sense, our unit begins from the actual (the extensive and the measurable) to the virtual (potentialities nested in mathematical relations). Consequently, what is at stake, does not respond to relations traversed by taxonomic and relational particularities of species and the individual but to abstract hierarchies of models and mathematical objects that manipulate the data.

Nevertheless, this idea does not aim to establish itself as a great provocation to the Simondonian thought. In the last and third part of the MEOT, he already approached this idea as well from his metaphysical analysis of culture as a meeting point between technology and the sacred: "Technology accomplishes, on the basis of plurality, a conversion toward unity, whereas ecumenism, first of all grasping unity, accomplishes or allows for the accomplishment of a possible conversion toward a plurality of social and political integration" (MEOT, 239). We shall return to this later.

We have selected a subject matter: the *automation of mathematics*, as we prefer to call it, also recognized as: artificial intelligence, automated cognition/learning or machine learning, to refer to a few of its names. The subject presents a particular difficulty for our theoretical-humanistic field when attempting to grasp (*erfassen*) and understand (*auffassen*) the concept as a synthetic unit of analysis beyond its different focuses, methods, multiple technical applications and infrastructures. On its basis, "[m]achine learning (ML) focuses on the design and evaluation of algorithms for extracting patterns from data" (Kelleher & Tierney, 2018, p. 1). Pattern extraction from data operates in conjunction with a complex non-linear process involving: the infrastructure for storing and analyzing data, the data sources, the type of data being processed, its preparation, its modeling, its evaluation and deployment and, at its very outset, the understanding of the business (i.e. the applications) (Sect., Part II).

Machine learning is not an unified object of analysis but is presented through *multiple technologies and methods* that can be combined and applied in critical and diverse contexts. This is a main reason why we shall not undertake particular use-cases or methods all along but we shall create *the philosophical effort to think of a major category beyond its merely applied sense and direct it towards its cultural relevance,* hence, we emphasize on the concept of *pattern* along the three sections.

> Difficult as any new conception may be, it seems absolutely necessary to try to formulate it, and then to learn from it possibly adequate new approaches. In practical terms I think such approaches will be the kind of study of patterns and relationships, in a whole process, which we have defined as the analysis of culture (Williams, 1961, p. 100).

Retaking Raymond William's vision on patterns and culture[7], that is precisely where we are headed. Patterns are ancestral (by nature), sense-giving (by human agency), automated (by technology). We are positioned in the latter phase. In the former process of ancestrality, we regard the pattern as a formed structure pertaining to a mathematical expression of nature itself (*Galileism*), for example, the Fibonacci sequence found in plants and galaxies. Regardless of whether there is a sense-giver human to conceive it, the pattern exists in nature and reproduces within it all around (Chapter II, § 1.). The historical phase of patterns is the one in which patterns are reproduced by human intermediation through *retentional technologies* (memory, language, techniques) recovering Stiegler's sense. In this stage, patterns are thus stored through symbolic milieus (for example, alphanumeric characters stored in stones, papers, punched tapes, and others) and reproduced at a higher speed and variation than the ancestral one. When it comes to the latest stage, readapting Floridi's (2014) concept, identified as "hyperhistory"[8], it is automated technology itself what transmits to other technologies most of the pattern formation processes without much of the human mediation while triggering, in this way, a displacement in the human civilizing task of mediating and transmitting information, namely, to give form, to in-form reality.

The concept of "ancestrality"[9] in Meillassoux (2006) implies removing the observer, the sense-giver, the subject who enters into correspondence with the world. With this, his realist scheme seeks to legitimize the existence of reality "in-itself" without the "correlationist" need for a subject to think or make sense of it. In other words, ancestrality entails the decentration of thought with respect to the world, but most importantly, behind this is the *absolutization of the*

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[7] We return to this along the section: Sect., Part III.: *Automated patterns of culture (the political-cultural axiom).*

[8] The contemporary philosopher of technology, Luciano Floridi, recognizes this historical-epistemological phase under the name of: "hyper-historical condition" that has emerged in contrast to pre-history and history through what he calls the "information revolution". In the pre-historical phase there are no means of recording the events of the present for future decision making, the historical phase is characterized by the instruments (stones, paper, etc.) through which human civilization manages to inform about its present to the future, in this sense it is related to technology but does not depend on it. In the third phase, which we are entering, the hyper-historical phase, technologies are responsible for mediating, processing and storing information processes with other technologies, largely displacing the human from the transmission circuit of information. An extended description on this is to be found in: Sect., Chapter II, § 3.: *Patterns of hyperhistory.*

[9] With this concept, he proposes to give an account through the notion "arche fossil", namely, about materials that indicate an ancestral reality, prior to terrestrial life (e.g. "the luminous emission of a star that informs us as to the date of its formation") (Meillassoux, 2009, p. 10). This topic is extended in: Sect., Chapter II, §1.: *Patterns of ancestrality.*

mathematical discourse. Meillassoux keeps returning to a question that we try to reframe here in different terms and with a different scope: "Would it be possible to derive [...] by way of mathematical discourse, reality in itself [...] and which exists independently of our subjectivity?" (2014, p. 29). The patterns that automated technology drives might be heading us towards such evidence.

In ancestrality the patterns exist as the mathematical expression of nature and in hyperhistory the patterns exist as the mathematical expression of technology[10]. Technology, in this sense, imitates nature in its continued reproduction of patterns. It is the concept of patterns that allow us to drop the veil of how computational algorithms in-form reality itself and perhaps clarify the "high road" concerning the very essence of technology. In both cases, ancestrality and hyperhistory, the anthropocentric mark of the meaning-giving, sense-giving human-world correlation *tends to* dissipate. Nevertheless, the cyclical reconciliation between ancestrality and hyperhistory is not to be found in the absence of correlation with the intersubjective, the human (meaning-bearer/ sense-bearer) but in their capacities to express, through patterns of formation, the deep mathematical reality behind phenomena.

The responsibility of philosophical thinking now is to account and elaborate the implications of the automatization and reproduction of these patterns *in* culture.

[10] For the extension on these notions, see, Sect., Part II.: *Patterns of technological evolution (the technological axiom).*

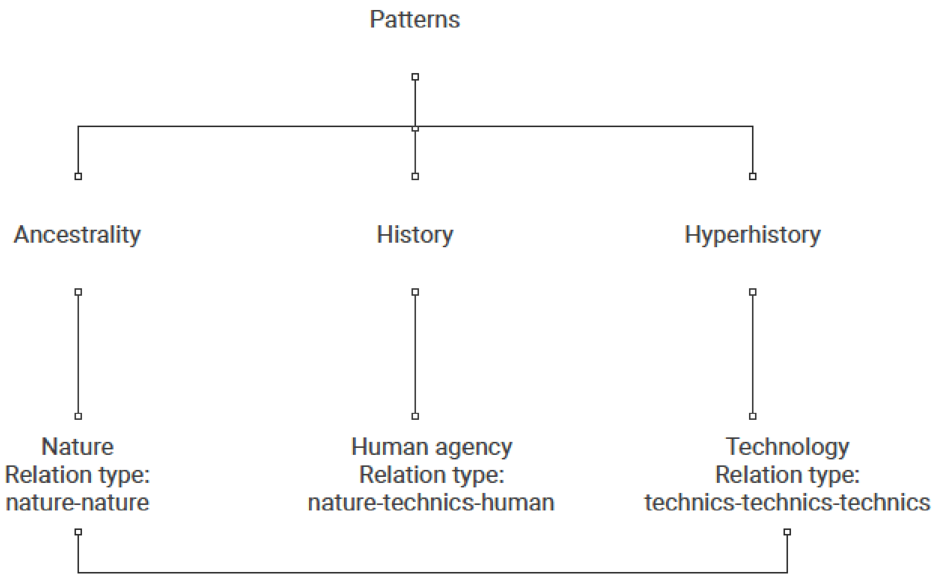

Figure 1. The notion of pattern expressed in its three instances[11].

If mathematical patterns are in-forming our reality: in what sense do these patterns bring together the evolution of machine and human cognitive agents? Does the evolution of artificial intelligence create the path towards des-individuation? Can the increasing multiplicity of techniques move towards collective unity and gather towards ecumenism in culture as Simondon once envisioned? What are its cultural and political effects? All these questions are only general opening referents of more acute and concrete problems that we intend to carry out throughout the work. This analysis does not aim to be understood as a historical nor merely technical description of use-cases in machine learning, this aims to be read as a descriptive cultural and political analysis in order to assert *how we move towards an automated pattern-based culture.*

When referring to the field of AI, the pattern finds its clearest position through the notion of "model" (Sect., Part II, §1. 1.1.) because it is from the mathematical model that the data is agglomerated and the pattern is able to be produced. A computational model is the mathematical representation of a system where the simplification and approximation to a phenomenon or object of reality is used for the simulation of scenarios allowing the prediction of the behavior of the phenomena in question. In this sense, what is most interesting is not the data but the

[11] All images within this work are my own unless otherwise indicated.

model that expresses the general pattern beyond that data. Therefore, the pattern enters here, in the gnoseological field of reality and that is what leads us to the most original sense of artificial intelligence (Sect., Appendix, Chapter IX, §1.).

An age of automated patterns implies the configuration of a culture where approximated forms (models) bring together and update relational attributes (data) whose possible relationships are always linked to a given pattern. After the declared end of metaphysics, AI, in an opposite sense, might have the ability to provoke a great metaphysical narrative.

With the purpose to approach such an end, our main research question is formulated under the following terms: *How is the automation of mathematics in-forming, giving form to political and cultural reality?*. Its answer lies in the very essence of technology. Our central hypothesis is: *machine learning produces «patterns in culture» towards the general, towards des-individuation, towards a pattern-based culture.*

Our period, recognized as post or hyper-industrial and where "automation itself is automated" (Domingos, 2015, p. 9), culture becomes almost indistinguishable from the image that automation has to offer. The pattern or model that reproduces and proliferates it, finds its deepest nest here, turning culture into a culture of numeric patterns able to fit within models. We have finally arrived at the age where: "Number governs cultural representations" (Badiou, 2008, p. 2). The increasing and spreading mathematical automatization unveils a culture of numerical and algorithmic nature that dilutes the *singulatim* around its patterns and models. When contemporary authors refer to "the danger of AI" in these terms, what they are deliberately hiding is the emergence of metaphysics by technological means (Sect., Appendix).

Understanding how the weights of an artificial neural network function in humanists textbooks can bring an accessible insight from different technical domains to the field but it might contribute little to morph contemporary cultural knowledge. We, therefore, choose to omit these steps which, in any case, already abound within the contemporary digital humanities literature and rather focus on the ontological-mathematical as well as cultural-political analysis. What is at stake is to grasp how models relate, divide and transform the space of cultural features into clusters of decisions and attention, arising in this way, psycho-social collective models of behavior.

This analysis is not arbitrary, nor does it respond to a philosophical affiliation; the automatism of patterns in culture is an explicitly political reading. Contrary to the political analysis from historical-materialist proposals, whose basesit is primarily in its empirical-material basis, politics here has its fundamental seat in abstraction, in the ontological-based problems. It is only from abstraction that politics becomes a clear system of pattern-rearrangements, patterns which are then multiplied and replicated at the different levels of society. The most relevant aspect about contemporary AI does not lie in its ethics[12] but in the political and cultural forms behind it. This is precisely what might be orchestrated behind the development of AI: “models for thinking the future of politics” (Morozov, 2013, p. 15) which, of course, implies the future of human decision and behavior. We are in the age of forms, of virtual platonism, of automated patterns, of an archetypal culture, but not because we have shaped it, this is the epistemic twist in which it is automation itself in-forming and generating our pattern-based view of reality. This is not merely a technical matter, much less a discursive matter, it is about the existence itself, its spaces for conquest and re-*arrange*ment (*arengen*).

We must warn the reader that we shall account, already at the very outset, adversities, and opposing forces that are socially and intellectually well-established and which can be found in the postmodern call for the end of metaphysics which has been very well received by the contemporary post-human agenda. As Jean-Luc Nancy (2003) pointed out, the well-meaning and naive discourses on the good use of technology do not account for these problems, such as the metaphysical problem on the essence of technology, which are the basis for understanding the image, now automated, of our era. In pursuit of a false scientific gesture, post-human and trans-human assumptions are beginning to dominate the image of our time for what we shall, briefly but critically, undertake to explain in the next two sections.

1.2. AI between simulacrum and metaphysics

Before considering Simondon’s genetic metaphysical terms for contemporary AI technology we are immediately confronted with a more complicated fixed-point problem that shall not be ignored: the contemporary belief that “we are at the end of metaphysics” (Badiou, 2005, p. 33). The contemporary french philosopher, Alain Badiou, underlines three pivotal orientations in the contemporary philosophical arena dominated by an anti-metaphysical view and a predominant role of language: hermeneutic (*interpretation*), analytic (*rule*), and postmodern (*deconstruction*). These orientations are enriching and brilliant in many of their

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[12] Against all well-intentioned attempts to codify a general ethics for the use of machine learning systems, Stiegler wrote: “Ethics, like justice, is what must be interpreted, and can thus never be codified” (2013, p. 25). In addition to this, the leading AI expert, Stuart Russell, explains: “A regulation such as «AI systems must be safe and controllable» would carry no weight, because these terms do not yet have precise meanings and because there is no widely known engineering methodology for ensuring safety and controllability” (2010, p. 251).

respects when dealing with "the passage from a truth-oriented philosophy to a meaning-oriented philosophy" (2005, p. 34) and cannot be synthesized without further ado since there are many distinctions between them and within their lines of thought, yet, they all organically share this anti-metaphysical stance.

One can reflect, as the signs of our times, the fact that the lack of universal schemes upon where to organize the representative production or, as we refer here, the image or *eidolon* of thought itself is, in turn, a limitation to explain by way of general frameworks, the instantiations of particular technologies that operate towards an increasing level of abstraction. Badiou, as a case of extravagance of our times, makes an open call to extract thought from this meaning-making circulation (which tends to subsume reality as a merchandising object of language) while trying to reconstruct a new doctrine around the subject and the truth.

> The world needs philosophy to be refounded upon the ruins of metaphysics as combined and blended with the modern criticism of metaphysics.
> I am convinced, and this is the reason for my optimism, that the world needs philosophy more than philosophy thinks (Badiou, 2005, p. 42).

Perhaps, as Simondon's genetic metaphysics asserts, this philosophical discourse must be reconciled with the most pregnant *universality*[13] [14] of our present time, that is to say,

[13] The idea of *universality* in computers was introduced for the first time by Alan Turing and implies that different computers are not required for different arithmetic tasks but that a single computer can calculate everything (Russell, 2020, p. 32). Cf., Turing, A. (1936). It is important to remark that Konrad Zuse's achievements and the ABC (Atanasoff–Berry computer) could achieve the same universality without depending on the notion of Turing's universal machine (Daylight, 2012, pp. 1, 2). This is explained again in section: Sect., § 2., 2.1.: *The automation of patterns by programmable machines.*

[14] In *Imagination and Invention* (1965-1966) Simondon emphasized the truly universal character of technical objects by exposing how they do not rely on the production of objects but on processes that constitute themselves, through an object, as a specific reality. Technics as a process-reality brings into contact different epochs and civilizations and becomes, in turn, independent of them. As an example of this, Simondon cited the case of the Roman Empire:

> [I]t is when technics encounters the object and forms it that it is constituted as a specific and independent reality, being able to transcend temporal and cultural barriers. Of the immense Roman empire, which was a masterpiece of organization in multiple domains, what has come down to us and still acts, is what was created as object, aqueducts, roads, bridges, residences (II, 178, own translation).

technology in its most generic sense. Pascal Chabot, a great specialist in Simondon's literature, analyzes the following:

> Technology's coming of age is not heralded by a new invention. It is announced by a book written by philosophers. This choice is telling: it expresses the fact that technologies outlive their technicians and that they are ultimately dependent upon the discourse that emerges concerning them (2003, p. 26).

> The nature of the superlative of progress is a question for general philosophy. It consists of defining an intention and an ideal. In order to ask these types of questions, we must depart from our description of technical lineages. Empiricism is no longer sufficient: the idea cannot be the result of a collection of facts; the intention is not the sum of all enquiries. The question of superlatives belongs to metaphysics. This is why it has gone out of fashion (2003, p. 129).

The need of metaphysics (i.e., knowledge representation) related to technology is also confirmed by a not-philosopher but prominent AI technical expert such as Margaret Boden:

> Unless one is a metaphysician at heart (a rare human passion), why should one care? and why should these arcane questions be "increasingly" pursued today? Broadly, the answer is that trying to design [Artificial Intelligence] raises questions about what ontologies the knowledge representation can use (2016, p. 38, with addition in brackets)

Today's critical attempts to subvert what remains of the metaphysical grounds are legion. This is deeply marked by the philosophical debates at least from the end of the 19th and beginning of the 20th century through the well-known "reversal of Platonism"[15]. How?

Also see the extension of this in Guchet's analysis (2010) in the section: *Du produit à l'objet technique.*

[15] This dictum is the Nietzschean program followed mainly by Deleuze. However, our interpretation, following Badiou's studies on Deleuze (1999) does not invert platonism but complete it.

> [...] the Platonic Idea is meant to provide a concrete criterion of selection «Copies» or icons (eikones) are well-grounded claimants to the transcendent Idea, authenticated by their internal resemblance to the Idea, whereas «simulacra» (phantasmata) are like false claimants, built on a dissimilarity and implying an essential perversion or deviation from the Idea. If the goal of

Principally this has been undertaken through three main attacks: i) the deconstruction or destotalization of the role of truth, ii) the emptying of logos (anti-logocentric view) and, above all, iii) the discrediting of representation. In a sense, contrary to these destructive impulses, the goal of AI since its inception has been to reconstruct *the image of representation itself,* to endow the machine with an image of thought itself (Sect., Appendix). In the contemporary state of attempts to undermine metaphysics, a significant contribution was made by Baudrillard (although he is one of the best critical postmodernists) when he made clear that *simulacra* precedes and produces the real: "It is all of metaphysics that is lost. No more mirror of being and appearances, of the real and its concept" (Baudrillard, 1997, p. 2).

The arduous entrance to rearticulate possible schemes of representation is precisely, as Badiou notices, due to part of the Nietzschean program of inverting Platonism as followed by Deleuze in order to vindicate the *simulacrum: "*<Consequently, «to overturn Platonism» means to make the simulacra rise and to affirm their rights> ([Deleuze, The Logic of Sense][16], p. 262; translation modified). Deleuzianism is fundamentally a Platonism with a different accentuation" (Badiou, 2000, p. 25, own modified bracketing[17]). In the realm of simulacrum, the posthuman agenda reserved a special seat for automated technology, particularly, for AI technology. The contemporary literature informed us that representation itself became part of the *simulacrum*, that it was declared as entirely absorbed by it. We write to invert this again.

The declaration of the end of metaphysics is the opening space of a problematic background (which entails many diverse discussions but at the same related aspects) constituting the "deep pixels" of the contemporary assumptions about our time. Within its broad spectrum, pioneer some (but not all) of the novel ideas and guiding beliefs under the umbrella-concept of: "posthumanism" or its referenced "posthuman"[18], especially when related to AI's contemporary agenda (but not exclusively). To some extent, posthumanist are reviving a system

> Platonism is the triumph of icons over simulacra, the inversion of Platonism would entail an affirmation of the simulacrum as such, which must thus be given its own concept. (Smith, 2006, p. 89).

[16] The name *Deleuze* and the *title of his work* had been own addition since the original citation uses an abbreviation.

[17] Hereinafter, we clearly state that all internal quotation marks belonging to a cited text have been changed from single and double to left and right pointing double angle quotation marks («»).

[18] Cf., Braidotti, R. (2013).; Braidotti, R. & Hlavajova, M. (2018); Braidotti, R. & Bignall, S., (2019); Rose, D. (2021); Sampaniku, E. D., & Stasieńko, J. (2021); Batzke, I., Espinoza Garrido, L., & Hess, L. M. (2021); Hofkirchner, W., & Kreowski, H. (2021); Polsky, S. (2022); Roy, K. (2022).

that devours those who worship it: while losing their own intersubjective trail, they profess to be *merging with* or *being registered by* digital technologies.

As reports keep coming in of an announcement of the end of "West resources" and the exhaustion of the subject, we have already had an enormous posthuman production: theories of a plug-in hybrid, which is not only a de-personalized and de-totalized subject but one that needs of the resources of a great narrative, such as the one of artificial intelligence. Baudrillard, with the lucidity and maturity of his analysis, is nonetheless, a motivating center for these (*merging with*) stories:

> Machines only produce machines. That is increasingly true as virtual technologies are perfected. At a certain level of machining, of immersion in virtual machinery, there is no longer a man / machine distinction: the machine is on both sides of the interface. (Baudrillard, 1997, p. 200, own translation).

Other contemporaries, also pioneers of the "post" spectrum, such as, Jean-François Lyotard, recognized that the difference between machine and human is not only cognitively based[19] (since we do not process binary units of information) but also their prompted indistinction is based on the discussions that "desire to «place» or «displace» «the debate about knowledge»" (Lyotard and Balghazi, 1993, p. 352). The displacement of the discourse about knowledge is not harmless. We already see in Lyotard's comment the latent risks of thought-displacement. Would this detachment (even explicit in the contemporary pioneer of postmodernism) imply that the discourses on AI in the literati spectrum also suffer the consequences of the multiplicity of discourses? Has the lack of systematicity been responsible for the puzzling new posthuman/ cyborg/ hybrids? One could answer this question by formulating another question: with, as announced by Lyotard, "the end of the great narratives", which is part of this end of metaphysics, *where does this new great narrative of AI take place?*, what underlying structures are legitimizing this predominant techno-scientific model?.

> What is being implemented is a worldview based on the techno-ideological postulate that there is a fundamental human deficiency that is going to be saved by the powers affected by artificial intelligence that are constantly increasing

[19] In his work *The Inhuman* (1988), he borrowed Dreyfus' analysis to clarify, from the beginning, the naive misunderstandings around AI.

and varying. And in this, artificial intelligence represents the greatest political power in history since it is summoned to personify a form of superego endowed at all times with the intuition of the truth and that guides the course of our individual and collective actions towards the best of all possible worlds (Sadin, 2018, p. 37, own translation).

This fundamental passage from Sadin summarizes the triad between human, AI, and truth as a representational problem which, fundamentally, is but a political problem. Many discourses rush into explaining the cause of it in the danger of the increasing extension of AI, as that uncanny (*das Unheimliche*) which provokes displacement in all walks of life, especially, in decision-making processes. However, the danger is to confuse reality with the instrument that refers to it or measures it. AI only continues the evolution of technics itself whose nature is expansive as already and rightly expressed by Jacques Ellul[20]. Language and technology, which are instrumental to thought itself, manifest themselves as concretized activities that, despite their potentiality (*dunameis* or δυναμεις), should not be confused with what they themselves refer to, that is, the symbolical reality or the *symbolical-milieu* underlying them. Simondon took this argument even further: "Consideration of what man produces (language, technics) does not permit evaluation of human progress, nor prediction of its law of development as a function of time, because attention is then solely directed towards the objective concretization of human activity." (LPH, 269, 270).

Although it might seem the strangest case, a lack of fundamental schemes, of truth-based reality brings, in turn, the versatility of discourses that give rise to another narrative taking obscurely that place. The lack of metaphysical foundations to think about the essence of technology, its micro-organizations manifested in culture and its unclear regulation in politics has moved to a discursive practice that led us to a scenario based on a fatal anti-humanist vision with a double twist: on the one hand, weather by promoting or by discouraging the debates about the possible eradication or replacement of the human by computational means (found in many of the posthumanist orientations), on the other hand, the convergence or enhancement of the human with its technological devices (mainly found in the transhumanist orientations). *Never in the living human memory has there been such a Kierkegaardian desperation from the human to move away from itself*, to become non-human or even so, a human who emancipates

[20] Cf., from Ellul: (1954); (1977) and also: (1988).

itself from being human by technological means, a post or trans-human. We have, so far, many semantic disguises but no subjects to wear it.

1.3. AI as the *Sísyphos* of Western culture

The automation of mathematics manifested in most of the machine learning (ML) techniques has been mostly confined to the debate around the concept of *algorithms*. These are operational entities, of a non-numerical nature, which have been captured as the representative picture of our times for a variety of reasons: the quantification of life *La Vie algorithmique* (Sadin, 2015), the transformation of critical thinking practices and knowledge production (Gillespie 2014, Mackenzie, 2017; Hansen 2021, Beer 2023), the access to the aesthetic realm *AI aesthetics* (Manovich, 2018; Manovich and Arielli, 2021), the radical transformation of industries *the Age of Algorithms* (Abiteboul, S., & Dowek, G., 2020; Iansiti, Lakhani, 2020), the new mode of thought beyond human cognition and control *algorithmic thinking/ thought* (Beer, 2022; Parisi, 2022), the production of social intelligence *Artificial Communication* (Esposito, 2022)[21]. Not to mention that we have also recognized their "governability" by the ever-replacing decision making, *algorithmic governance/ governmentality* (Berns & Rouvroy, 2013; Cantero Gamito, M., Ebers, M. 2021), "automated management" (Kitchin & Dodge, 2011), *algorithmic accountability* (Diakopoulos, 2015), and a lot more. Still greater, we have believed them to be bearers of their own *vis a tergo*. Some, more than others, struggle to endow it with a call to an end (end of the human, of meaning, of intersubjectivity, of thought, of critical thinking, of the author, of culture, of human *érgon* (operation-work), and the ends keep rising *à la page*).

Any claim to endorse technologies, in general, with an end, is to make them bearers or *Sísyphos* for the self-proclaimed death of metaphysics or as Nancy refered "the completion [...] of the West's resources of signification and meaning (God, History, Man, Subject, Sense itself...)" (2003, p. 4). Assumed as part of the necessary difficulties of our time, we are facing, for more than two centuries already[22], a solid programmatic tendency against metaphysical

[21] For an extended use of the concept among diverse authors within the context of culture, see Sect., Part III, Chapter VIII: *Culture as the meta-pattern.*

[22] The scientific revolution from the 20th century which turned Aristotelian, Euclidean and Newtonian theories upside down, required a different model of mathematics able to explain and organize the data of reality from gnoseological and not from a metaphysical point of view, that is, from the knowledge of the contents and processes

thinking [23] mainly recognized for establishing an isomorphic relation between the *structure of thought* and the *structure of reality*. Nevertheless, contemporary philosophy does not hold the thesis of truth as a correspondence between thought and things but as an *unveiling* (Heidegger), a *rule production* (Althusser), an incalculable and unpredictable opening called *event* (Badiou), a deposit of the speech in the *Other* (Lacan) (Badiou, 2005, p. 65).

Thus proclaimed, the death of metaphysics, a new repetitive and indeterminate process must be sought, a new rock to carry on *Sísyphos* back, this rock is called: "the *simulacrum* of culture". In a way, the "simulacrum of culture" reassures the human from the advent of a new end: "We require a visible past, a visible continuum, a visible myth of origin, which reassures us about our end." (Baudrillard, 1997, p. 10).

A revealing light on these currents is shed by the student of Badiou, Quentin Meillassoux, by mean of his concept of "correlationism":

> I call "correlationism" the contemporary opponent of any realism. Correlationism takes many contemporary forms [...]. But although these currents are all extraordinarily varied in themselves, they all share, according to me, a more or less explicit decision: that there are no objects, no events, no laws, no beings which are not always-already correlated with a point of view, with a subjective access. Anyone maintaining the contrary, i.e. that it is possible to attain something like a reality in itself, existing absolutely independently of his viewpoint, or his categories, or his epoch, or his culture, or his language, etc.- this person would be exemplarily naïve, or if you prefer: a realist, a metaphysician, a quaintly dogmatic philosopher (2014, pp. 9-10).

In this context, not only it is proclaimed that reality and its excesses have been absorbed by the limits of language, but even more, it was only the beginning of an even more profound misunderstanding which seems to force all contemporary digital agenda to write under the already intentionally established paradigm of *posthumans, transhumans,* and *cyborgs*,

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of the mind and not from reality "as such" or from the nature of the world. One of the first to carry out the task of taking the human mind as an object of experimentation was David Hume particularly in *A treatise of human nature*. Cf., Hume, D. (1988).

[23] Not including the "analytic metaphysical" turn of the seventies and nineties. Cf., Quine, W. V. (1969). Also, around the 1990s there was the so-called "Hegelian turn" in analytic philosophy by means of Sellar's work which inspired McDowell and Brandom. Cf.: Reynolds, J. (2010).

morphing (by means of a language-based or sense-based reality) an increasingly de-anthropomorphized landscape of technology.

The discourse about the all-encompassing technical objects or technological devices[24] as the most liberating possibility from the very human condition sprinkled the seeds of invisible mechanisms or engines capable of making use of the power of anti-human forces[25] [26] or as, in a moral sense, Bertrand Russell referred to the "anti-human tyranny" (1910) and Anders (1980) as the "Promethean shame" (*prometheische Scham*)[27] as well as Stiegler (2013) as the "shame of being human". These positions are to become a growing object of concern as warned, but not only, by the philosopher Lyotard (*The Inhuman*, 1991) and the computer scientist Lanier (*You Are Not A Gadget: A Manifesto,* 2010). Concerns which do not imply a technophobic opposition but an opposition to the very human responsible for elaborating them. Algorithmic mediations do not come to annihilate the human subject to the detriment of its own particularity or subjectivity and, if so, it is formulated under the political reading of human-machine analogy

[24] On the difference between, on the one side, technical objects as limited to terms of the same order of magnitude and, on the other side, technological devices as encompassing greater orders of magnitude or, as Bontemps names it, "amplification instrument" (2016, p. 42): cf., Simondon (1970) *On the birth of technology* (NT), and also, Bontems, V. (2016).

[25] Lanier expressed on this topic the following:

> Some of the fantasy objects arising from cybernetic totalism (like the noosphere, which is a supposed global brain formed by the sum of all the human brains connected through the internet) happen to motivate infelicitous technological designs. For instance, designs that celebrate the noosphere tend to energize the inner troll, or bad actor, within humans (Lanier, 2010, p. 45).

[26] Concerning today's loss of meaning, responsibility, and reason itself, Stiegler noted: "a stupidity that has everything to do with the baseness of thinking, and which, here, must necessarily be related to horror – to that which confronts humanity with the shame of being human" (2015, p. 42).

[27] The threatening disposition of technical entities inverted the order of Hellenic thought where it occupied a passive and devalued place (Stiegler, 1994) understood in terms of "available matter", whose ends were merely instrumental and modifiable by the active human role of "form-giver". However, the interwar period of the 20th century placed the human being (previously active executor of form and meaning) as passive *homo materia* (*Rohstoff*), i.e., the orders between available matter and form-giver were reversed. The Promethean creator became raw material available to be transformed by his own technological productions (Anders, 1980). The discourse of the "Promethean gap" (*das prometheische Gefälle*) was later identified by Agamben in the war context as "organic waste matter".

but not an epistemological one. There is a plentiful supply of arguments in the opposite direction:

> "[A]lgorithmic governmentality does not allow for subjectivation processes, and thus for recalcitrance, but rather bypasses and avoids any encounter with human reflexive subjects. Algorithmic governmentality is without subject: it operates with infra-individual data and supra-individual patterns without, at any moment, calling the subject to account for himself" (Rouvroy, 2013, pp. 144-145).

In this context, AI has unfairly taken hostage by an hostile antihumanist view which shall be aware that such mediations neither bring to an end nor give rise to any new subject but allow a *new appearance of the same subject.* New ways of accessing information and above all, the automated processing of it through digital machines, opens the way to the possibility of modulating subjectivities in a different way than previously known. For the first time in history, enormous volumes of data are processed and computed in such a way that it is possible to maximize predictive power. In a nutshell, this is what a *programmable era* is all about: aggregates of bits that relocate behavioral structures and reorganize patterns of the social world. While the subject has been drowned in the ocean of post-human micro-narratives, we are being structured by a system of forms and models, of imperceptible patterns and automations of behavior.

This scenario leads us to make a critical call not on the figure of the algorithm but on the mathematical substratum on which algorithms operate. On the same page as Badiou (2005 [cf. 1988]), mathematics reveals, as in any epoch, its ontological essence. We find ourselves in the epoch in which technological participation *(μέτεξις)* has profoundly modified the cultural scenario which is increasingly based on observable and inobservable patterns. The automated re-organization leads us to a re-examination of the concept of *pattern* and its relation and potentiality regarding in-*form*ation processes for accounting culture and society.

We aim to provoke a philosophical and political response to the emerging constellation of patterns that unfold as a product of the automation of the mathematical (mainly statistical) domain. From this kernel, several questions stand out: What do we mean by automation of mathematics? Can the automation of mathematics shape the patterns, the micro-constellations of data that modulate subjectivity? What type of potentiality do these patterns hold? Or as Deleuze reflected when thinking about the reality of the virtual: "[...] which part of the mathematical object presents the relations in question and must be considered derived?" (1994 [c. 1968], p. 209).

This initial seed aims to clarify the scenario of the main problems and limitations we have inherited. But, above all, we have pursued this section in order to make explicit from what point of view we decide to think about the new philosophical and cultural conditions in which AI techniques are inserted.

1.4. State of the art: the main theoretical fields on digital studies

In a sense, the associated practices of *new media technology* have modified the way in which we understand the possible modes of relationships, and above all, relationships with the transformative capacity of ever becoming, of transforming themselves. Nevertheless, there is an unclear common thread that facilitates terminological leaps between different areas of analysis, "becoming" leads straightforwardly to the notion of "performativity" and this one to that of "knowledge". It is at this point that human-machine analyses are often erratically referred to as "epistemological" types of analysis. Since performing does not strictly mean knowing, just as simulating does not mean being, various inaccuracies of terminological uses within the contexts of cutting-edge technologies have been developed. But it is also clear that it is a complex challenge for us, in the humanistic field theory, to traverse the mathematical-computational field without running the risk of compromising the cited technical resources.

Collateral theoretical inconsistencies have also arisen nominal expressions without defined correlates, which, in the absence of probing the interdisciplinary nature of the field, produce rather promethean fictions. But how have we come to stir up the fantasy of achieving a "purified automaton", such as AI, based on our own image, an almost mythical manifestation of our time?. Simondon, already recognized in the second half of the 20th century, the growing "myth of the robot" and the dangerous analogy between the machine to the living:

> However, for this general technology to make sense, one must avoid the improper identification of the technical object with the natural object and more specifically with the living being. External analogies, or rather resemblances, must be rigorously banned: they have no signification and are only misleading. Dwelling on automata is dangerous because it risks limiting one to the study of external aspects and thereby to improper identifications. (MEOT, 50).

This might have been transferred, not without lesser imagination today, to the field of AI. The sociologist Sherry Turkle recognizes that it was only by the mid-1980s when the computer arose philosophical questions regarding their abilities which, as a consequence, created the conditions to *match* mental processes from one side to the other. For her, it was in this sense that "computers brought philosophy down to earth" (2005, p. 2). Nevertheless, philosophy not only does not need computation in order to approach the realm of thinking, it also does not need to be brought down to earth in the first place. In accordance with philosophers from the size and variety of Heidegger, Deleuze, and Badiou, the question for the actualization of mental processes into a threshold of thinking can only be reassigned via an ontological analysis. In this respect and moving towards Badiou's ontological reading of mathematics, philosophy does not require to be brought down to earth; it requires to ascent out and this is *not* by means of computation but by means of mathematics which is able, later, to give birth to computation in the first place: "if it is correct that the philosophers have formulated the question of being, then it is not themselves but the mathematicians who have come up with the answer to that question" (Badiou, 2005 [c. 1988], p. 8).

The difficulty in reorganizing the pieces of the current state of the art (see, figures 2, 3, and 4) is due to the fact that a large part of the discussion is configured more through theoretical demands than through clear and regulated conceptual organizations or sufficiently clear correspondence/disruptions with respect to historical-epistemological traditions. At the same time, even supposing that the authors who position themselves in a thematic within the field of digital studies start from similar assumptions, in effect, they start from different anthropological-ethical and maybe even, metaphysical positions. Floridi takes a clear position in highlighting the current conditions of the field:

> The profound and widespread transformations brought about by ICTs have caused a huge conceptual deficit. We clearly need philosophy to be on board and engaged, for the tasks ahead are serious. We need philosophy to grasp better the nature of information itself. (2014, p. ix).

The philosophical-cultural approach to the phenomenon of automation is dominated by thematization of ontological, epistemological, ethical, and political debates around the origin, the scope and the extension of computational automatism or automated learning within a digitally organized environment. Narratives on automatism hold an interdisciplinary discussion based on different assumptions and large methodological discrepancies for their analysis and, in turn, contain various schools (or a-synchronic schemes) of thought, some of them subsidiaries of others and therefore belonging to different categories and concrete objects of analysis.

Nonetheless, within the relevant lines to the philosophical and cultural debates, which engage, collaborate and transform to each other, we trace three nodes or lines of researches upon the humanist digital field focused on AI:

> i) A logical-epistemological baseline: problematize automation/learning techniques from their cognitive, symbolical or perceptual aspects under consideration of technical-scientific frameworks.
>
> ii) An aesthetical-socio-cultural baseline: AI is problematized through their points of contact with society and how their mediation modifies cultural and subjective experiences.
>
> iii) An ethico-political, political-philosophical or geopolitical baseline: problematize the object of digitality in general and AI in particular through the problems posed to e.g., liberal democracy, the exercise of power, the rule-making, the system of multiple agents at stake, and others.

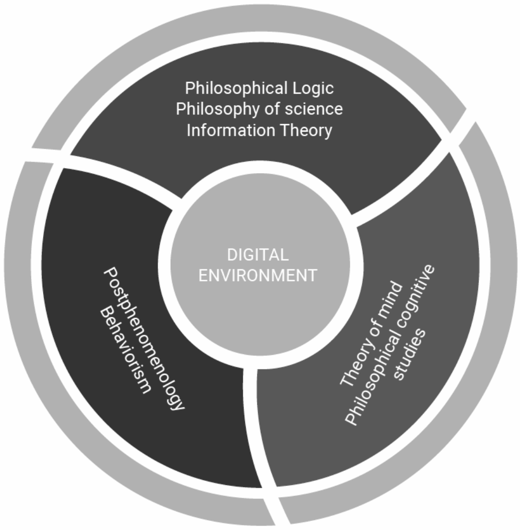

Figure 2. First node. General view of the fields of studies related to a logical-epistemological baseline for the analysis of the digital environment

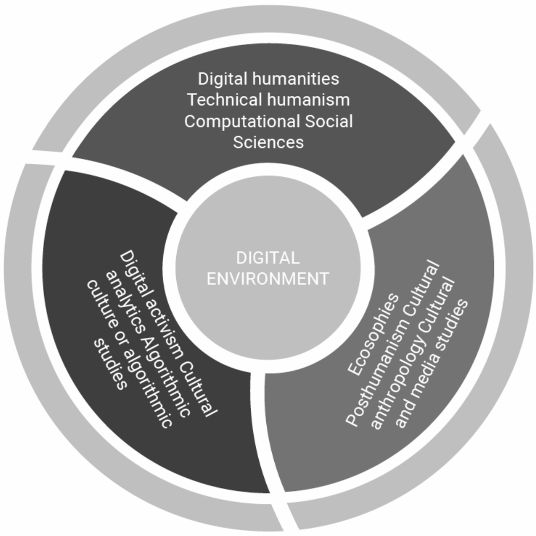

Figure 3. Second node. General view of the fields of studies related to an aesthetical-socio-cultural baseline for the analysis of the digital environment.

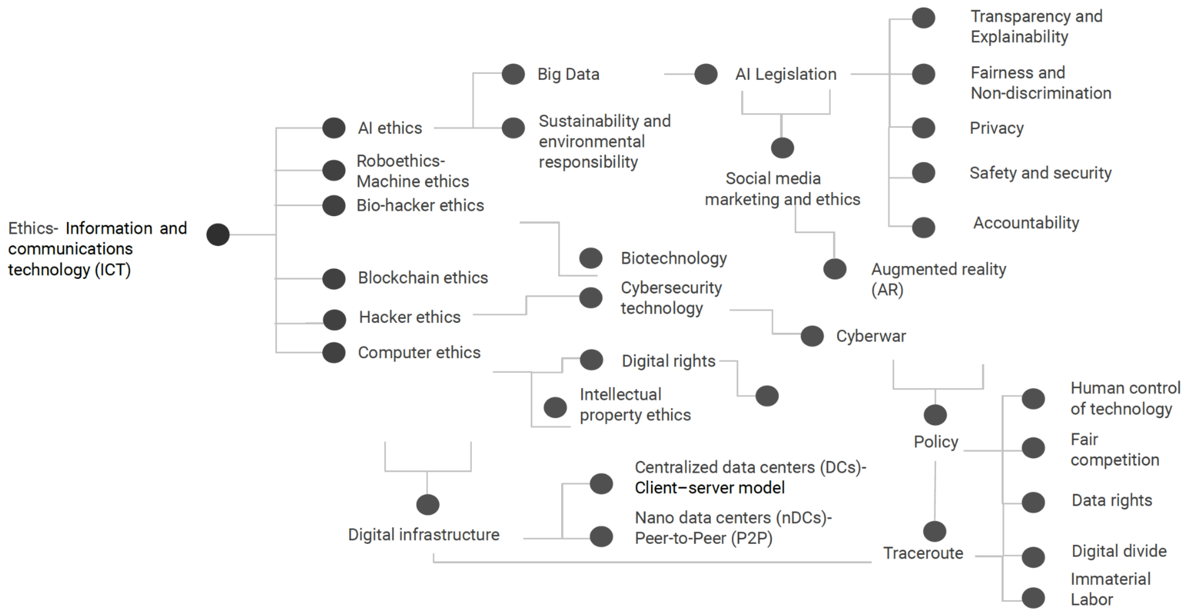

Figure 4. Third node. General view of the fields related to the ethics, rights and policy of the digital environment

i) From the former (the first node), it is possible to recognize, in roughly general terms, some of the following working lines:

i. *Philosophical logic*: The similarity in philosophical logic and logical research in theoretical AI through the common problem of *reasoning* has been of great importance since the very origins of AI[28] mainly for symbolic AI approach back to the fifties. Logic has a long standing tradition which, as a meta-disciplinary field, is still able to place a dialogue between philosophy, mathematics and computational sciences. The french computer scientist, Jean-Gabriel Ganascia, points out that AI learning mimics mechanisms, such as the inductive procedures guided from the particular or finite experience to the general knowledge which were already legitimate by philosophers since Aristotles (384–322 BC): Sir Francis Bacon (1561-1626), John Stuart Mill (1806-1873), Jules Lachelier (1832-1918), Rudolf Carnap (1891-1970), Jean Nicod (1893-1931), Carl Gustav Hempel (1905-1997), Nelson Goodman (1906-1998), Jaakko Hintikka (1929- 2015) (Ganascia, 2006, p. 91).

The most explored approaches in this field have been propositional logic and first-order logic. These do not admit uncertainty and were regarded as unsatisfactory especially since

[28] A good introduction to this interdisciplinary and interrelated fields of logic and AI can be found in: Brachman R. and H. Levesque (1985). Also in, Thomason, R. (1989).

Carnap (1936)[29] for not being able to grasp the complexity of cognition (agent's beliefs about facts) and theorem proving which are computationally intractable[30]. But not only has logical formalism been of crucial importance in the AI symbolic scene, also logic plays an essential role for statistical learning as well (Gold 1967, Valiant 1984, Vapnik 1995, Halpern and Pearl 2001). In machine learning, the simulation of inductive mechanisms through structural induction based on "experiences" goes beyond formal inductive theories. However, the introduction of first order logic in probabilistics representations and machine learning resulted in statistical relational learning mainly known as "probabilistic inductive logic programming" (PILP) which addresses many contemporary AI applications such as bioinformatics, robotics, and many others[31].

ii. *Philosophy of science*: the scientific methods and inductive strategies which dates back to the long-standing philosophical traditions, such as, those preceded by Sir Francis Bacon (inductivists) and Sir Karl Popper (falsificationists) (Gillies, 1996, pp. vii-viii), particularly, in relation to computational programs able to make inductive inferences based on observational procedures. The practice of automation of scientific hypotheses gives a new air to both of these traditions in the philosophy of science. An account of the main relations of machine learning to philosophy of science can be summarized in the following terms:

> This link is based around an analogy between hypothesis choice in science and model selection in machine learning. The task of determining a scientific hypothesis on the basis of current evidence is much like the task of determining a model on the basis of given data (Williamson, 2009, p. 3).

iii. *Postphenomenology*[32]: the focus on human-technology relations retakes many of the contributions from the field of phenomenology regarding the perceptual field or situated sensations. Mostly based on empirical analyses and case-study approaches of digital technologies who regard technological artifacts as a common mediation of human experiences. The study of algorithmic agency, became a key case-study from the field because of its

[29] Cf., Carnap, R. (1936).

[30] On this topic, Cf., Levesque, H. (1989).

[31] Relevant to this, Cf., De Raedt, L. (2008).

[32] For an introductory reading on postphenomenology: Rosenberger R. & Verbeek, P. (2015).

perceptual recognition tasks (such as the recognition of objects or fixed shapes (*Gestalt shifts*) in terms of Selinger (2006)). Such bridges had even led this school of thought to the statements such as the "hermeneutic machines" (Hongladarom, 2020). This field of study is also paired and inspired by the object of its discussions concerning algorithmic mediations (both from the phenomenological and the ethical sides) with speculative realism and object-oriented ontology. The latters, mainly inspired by[33] Latour's concerns regarding the agency and relationship between materials, objects, machines, and tools.

iv. *Behaviorism*: following the generalization made by Murphy (2019), when related to AI, this subfield emerges as a response to the Cartesian body-mind debates which frames the principle of representation under clear and distinct ideas and where knowledge operates as a product of such mental states. In the opposite sense, for behaviorism, the access to knowledge is not due to the properties of the mind but rather it is accessed through external behavior within the environment at stake. For example, the simulation displayed by a computer (e.g., Turing Test) is a fairly expression of intelligent behavior when achieving the goal (e.g., passing the Test).

When what is at stake is the behavior of AI programs, it is the behavioral sciences, an interdisciplinary field based on the observational and methodological-experimental task of interaction processes with the environment, which carry out the task of observation, analysis, understanding and creating the behavior of AI agents. The study of the behavior of artificial phenomena and decision techniques has had as a point of reference the studies of Herbert Simon, particularly in: *Administrative behavior* (1947) and *Sciences of the Artificial* (1981). At present, this recent field of study has been identified by the team of behavioral sciences researchers at MIT as "machine behavior"[34] (Rahwan, et. al, 2019).

v. *Theory of mind or philosophical cognitive studies*: functional analogies taken from the cognitives abilities with respect to the, not yet fully understood, nervous system from animal/human cerebral cortex, particularly in observation of the field of ML. This innovative field coordinates the methods to understand the integration of attributes and inferences carried out by human cognitive mental states and their modeling in computational cognitive mental states. The pioneering philosophical analyses of this area are to be found in the works of Marr

[33] Cf., Harman, G. (2009).

[34] More on this: Cf., Rahwan, I., Cebrian, M., Obradovich, N. *et al.* (2019).

(1982), Dennett (1994), McClamrock (1991). From these movements, for example, the "extended theory of mind" reaches fruitful analyses, especially as found in Andy Clark and David Chalmers (2002) whose influence can be previously traced in Hilary Putnam (1975) and Tyler Burge (1979).

vi. *Information theory*: the study of agents as informational systems in terms of information processing: receiving, storing, transforming, generating and self-regulating information. It is regarded as a transdisciplinary and computational field initially reinforced by the philosophy of artificial intelligence (algorithmic symbolic procedures performed in a Turing Machine) towards connectionist models (Floridi, 2011, pp. 35-54). The new paradigm of computer revolution called, "the Fourth Revolution" by Luciano Floridi and its paradigmatic field of study called, "Philosophy of Information"[35], sheds sharp light on the notion of information from its quantitative, semantic, physical and natural/ essential aspects as well as it leads to the most updated state of the art between ethics and artificial intelligence.

ii) The second node follows from the different fields of study, the *ethico-political-aesthetical-socio-cultural* approaches. These occupy the capital vector of the digital environment for emerging and transforming conceptual tools, research frameworks, critical analyses and even epistemic alternatives within very diverse fields of study. In most of these analyses, it is proposed to reconstruct the historical and analytical shift of the new landscape: the *digital kosmos*. This shift is described by some as fundamental, pregnant, and all-encompassing. This is achieved under central theoretical concepts and where the study of AI (though not explicitly mentioned in all cases) together with networked and programmable media becomes a decisive point for most of the research lines.

In the neuralgic focus of the discussion about the digital phenomenon or digital media, new extensions of technology open questions about the description of perception, experiences and composition of subjectivities regarding the knowledge of cultural objects and the social

[35] The contemporary international reference as a philosopher of technology, Luciano Floridi, manages to give structure to many of the concerns that surround the digital environment, as already mentioned, under the terms: "philosophy of information" and tries to gather in it, in turn, other terms those he considers fashionable or of a specific theoretical orientation: "cyber-philosophy", "digital philosophy", "computational philosophy", "formal epistemology", "philosophy of computing", "philosophy of computation / computation", "philosophy of AI", "computers and philosophy", "computation and philosophy", "philosophy of the artificial", "artificial epistemology" (Floridi, 2011, p. 20).

universe. Within the field of social[36] and cultural studies there are various conceptual categories that gather and critically explore some concerns, *ethos* and common semantic meanings. Meanwhile, questions are endlessly emerging as to whether there are self-consistent conceptual architectures with coherent articulations able to provide theoretical-philosophical foundations for the new relationships between the social universe and the algorithmic mediations. Such efforts are also found in the commitments of digital humanism to enhance the critical debates born from the subjective experiences.

The following general conceptual categories offer context, meaning and interconnection and even political input in relation to today's technological phenomena: "digital humanities", "technical humanism", "computational social sciences", "digital activism", "cultural analytics", "algorithmic culture or algorithmic studies", "ecosophies", "posthumanism", "new materialism", "new/ media theory", "cultural anthropology", "cultural studies", "communication and media studies", "comparative literature", among many other subfields which position themselves on one side or the other of the rivalry between humanist and post-humanist currents[37] .

Today computation permeates all possible areas with greater rigor, and has also been transformed as a discipline through its own developments. But it has not only produced new mathematical objects (machines and programs) and technical revolutions, it has also produced conceptual explosions. Through them, categories of contemporary thought related to humanity, technology, political systems and environments as well as their interactions are debated and articulated, to name only a few: "General organology" (Stiegler, 1994), "Network society/ Information age" (Castells, 1996), "Global information culture" (Lash, 2002), "Information society" (Webster 2004 [c. 1995]; Mattelart 2003), "Anthropocene"[38] [39] (Crutzen, P. 2002; Davies, J. 2016), "Capitalocene" (Moore, J. 2016; Haraway, D. 2015), "Accelerationism"

[36] Some of them, despite not being formally within this node of analysis but contributing to the task of forming the aesthetic and social phenomenon around the digital environment, combine their analysis with the application of computational methods, such as the fields of: anthropology, archeology, geography, social sciences, data journalism, among others.

[37] For an extended list of contemporary authors in these working lines: Cf., Braidotti & Hlavajova (2018); as well as from the Hispanic world: Parente, Berti, Celis (2022).

[38] According to the *Posthuman Glossary*, see also the following terms: Chthulucene, Resilience, Expulsions, Extinction, Hacking Habitat,, Earth, Four Elements, Posthuman Critical Theory, Ecohorror, Extinction (pp. 45-53). Also see, Gane, N. & Beer, D. (2008).

[39] Criticisms of the "anthropocene" as a myth and ideologizing position can be found in: Malm, A. (2015).

(Srnicek, & Williams 2013), “Hyperobjects” (Morton, 2013), “Technosphere” (Peter Haff, 2014), “Tecnoecology- General Ecology” (Erich Hörl, 2015), “Cosmotechnics” (Yuk Hui, 2016), among many others. These are concepts, through which, it is intended to grasp while creating the path for new subjectivities, agency, objects and institutions whose relations are all of them crossed by algorithmic-digital mediations, and their new causal nexuses. These analyses enter into a new type of relationship or *milieu* that operates in accordance with technological development, also considering, in many of its cases, its environmental impacts.

In the digital humanities or digital media, in general, the analyses related to the digital infrastructure have taken shape through various critiques of divergent emphasis, each of them unraveled by different perspectives that can be roughly simplified or reduced under a grand *Weltanschauung* focused on the critique of an industry of hyper-control through algorithmic automation directed by technological elites[40]. From these critiques, objections and/or observations (which encompass much more than the present alluded simplification), emerges conceptual triggering instruments such as; “cybernetic totalism” (Lanier, 2010), “siliconization of the world”/“technopower” -*la silicolonisation du monde*- (Sadin, 2016), “algorithmic governmentality” (Thomas Berns and Antoinette Rouvroy, 2013), “computational capitalism” (Stiegler, 2017), “psychopolitics” (Han, 2017), “surveillance capitalism” (Shoshana Zuboff, 2018), among a much more extended list[41].

iii) The third node encompasses the degree of flexibility on the consensus and interaction of the agents/users to the access and production of information which, of course, reconfigures a political and social space no longer based merely on the exercise of power and rule-making, but on a “multi-agent political system” (Floridi, 2014, p. 185). The number of actors and stakeholders at play in the development and socio-economic impact of digital technologies (particularly what is recognized as cloud and data technologies), reconfigures the economic-political-social scenario on a global scale. Such an event extends the interests that problematize the object of digitality in its most generic sense, among them are: civil society, governments, inter-governmental organizations, multi stakeholders, private sectors and others (Fjeld, et. al., 2020) as well as in their specific use-cases: data infrastructure, business analytics,

[40] On this discussion, see, Brown, W. (2015); and Slobodian, Q. (2018).

[41] On how this field is related to machine learning, Cf.: Sect., Part III, Chapter VII, § 1.: *A culture based in the image-of (Eikasthénoi) its patterns.*

artificial intelligence, applications linked to business and industry, open source software, data source, APIs[42], and others.

For all these cases, there are incoming designs of ethical guidelines that regulate the uses of AI and the technologies in vogue without undermining norms and standards, fundamental international human rights, regional and/or domestic regulations, the sovereignty of the digital infrastructure, among others. The AI pioneer, Stuart Russell noted: “Many governments around the world are equipping themselves with advisory bodies to help with the process of developing regulations; perhaps the most prominent example is the EU’s High-Level Expert Group on Artificial Intelligence” (2020, p. 251).

Behind such regulations hides the attempts to avoid the automation of social control, from which, two frontal attacks are roughly derived: On the one hand, the economic-political attack on the monopolistic markets that concentrate the hyper-scale of data centers, also recognized as the “four horsemen of the *digital* apocalypse”: Google (GCP), Amazon (AWS), Microsoft (Azure), Facebook (II)[43]. The four horsemen of the apocalypse initially refer to Google, Amazon, Microsoft and Apple (see footnote 44). In a not so gradual way, these companies would already happen to exercise an economic-political power that we could consider of “supra-state” type. To this configuration of power Lanier writes: “Digital network architectures naturally incubate monopolies” (2010, p. 19). On the other hand, a second type of attack derives from its epistemological and ethical roots. This critical aspect fundamentally rejects the set of computational instances involving automation in decision making for undermining human intersubjectivity and posing a danger to democracy. The latter also implies a society of strongly economic, calculable, measurable and predictable registers, a thesis that is attached, according to a large percentage of critics, to the ultra-neo-liberal program or agenda. Regarding the latter critique, it is significant not to generalize or group the problems (referring to the criticisms of the neoliberal program). However, on the first type of critique, there is a great discursive intercalation or tension between those considered “anti-democratic practices” and the “lack of state regulations”. In such critics, on the one side, the demands for greater presence and regulations coming from the state may, in turn, imply subjugation to the market practices of technological development, as well as, on the other side, the lack of regulation of

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[42] For a further development on these use-cases visit the benchmark map of key trends in data and cloud technologies made by: Turck, M. (2020). Also a detailed description focused on business analytics and big data in Schmarzo (2013) with even more extensive detail of data storage infrastructure in Kelleher & Tierney (2018).

[43] In the mention made here, Facebook’s data center campus (the cloud) proves predominant to Apple’s because Apple’s encrypted files (iCloud) are stored and linked to the first three.

the latter may undermine principles and human rights *in extenso*. In the difficulty of these horizons, one can rather identify that state and private regulatory practices are confronted to operate with such proximity in the age of digitality that their practices have been mutually distributed across rules and economic operations globally. Especially, if we refer to the area of technologies operating with AI techniques. As the French mathematician and politician, Cédric Villani underlines: "we cannot conceive of AI in a purely national framework" (2018, p. 4). The political phenomenon of AI requires to be thought of in an international context simply because a society organized by its data exceeds the frames of all domestic politics.

We find ourselves, *iterum*, within an arduous and noble task, which is, to analyze and rearticulate the relations between the *general* and the *particular*, a new returning to the ontology of generalization and specialization. In more socio-political terms, between what regulates (algorithmic mediations) and the regulated individual interests (fundamental rights and freedoms). Every epoch, where a new grand narrative has been nested, has the spiritual and political task of making these narratives culturally clear. In the case of AI, it is the 21st century narrative that still needs to set its technological developments within general theoretical frames. This might lead us eventually to the possibility of a political philosophical or cultural program aimed to assume a new doctrine about subjectivity itself (again, not a new subject but a new appearance of the same subject). Such a project shall not respond to -the merchandising of language- but to a structure capable of coherently accounting for the way in which the patterns of culture reprograms and reupdates themselves by means of algorithmic mediations while contributing to give form to this new cultural horizon.

CHAPTER II

The three stages of patterns

§ 1. Patterns of ancestrality

Before the explicit (foreign or *heteropoetic*, borrowing Canguilhem's expression) technical intervention performed by human agency, the pre-established harmony of patterns found their original place in the physical *kosmos*, in the "things by themselves" (*physei*). What we coined as "patterns of ancestrality" are regularities, similarities, and differences of and between patterns that abundantly repeat in most of the vastness of the universe[44] and in nature[45] *not* owing their very existence to human intervention. In the letters of Walter Benjamin, he expressed his appreciation about the *ideas in nature* not open to human language and different to history. In this sense, he stated that ideas (namely, *patterns*) are like stars, since they: "do not shine their light into the day of history, but work within it invisibly. They shine their light only into the night of nature" (Benjamin, 1994, p. 224). Patterns also bear this ancestral force.

At a later stage, the patterns of ancestrality bestow living organisms (ranging from low to highly developed species) the effect of *order*[46] to their sensory perception. The inherent order

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[44] Cassirer offered as examples: the trajectory of stars, the shift from day to night, the regular return of seasons (2000, p. 1).

[45] To name only a few: "the bee's honeycomb, animal markings, the spiraling of seeds in a sunflower head, the six-pointed star of a snowflake" (Ball, 2016, p. 6).

[46] «Order», in this context, means a regular, stable environment for our action, that is to say, a world in which the probabilities of events are not distributed at random but arranged in a range of possibilities so that certain events are highly likely to occur while others are less probable, some others virtually impossible. Only such an environment do we understand. (Bauman, 2000 , p. xiv). Order as related to probability distribution and therefore, to (cultural) patterns had been greatly argued by Bauman in the following quote:

> To «make order» means, in other words, to manipulate the probabilities of events. If it is a set of human beings that is to be ordered, the task consists in increasing the probability of certain patterns of behaviour while diminishing, or eliminating altogether, the likelihood of other kinds of conduct. That task entails two requisites: first, an optimal distribution of probabilities has to

in nature, that is, what we later discover in terms of the mathematical order, emerges as a prelude to a *pattern worldview.* Cassirer in, *The Logic of the Cultural Sciences,* wrote:

> Matter as such proves to be permeated with the harmony of number and to be ruled by the lawfulness of geometry. [...] The world is one, as surely as the knowledge of the world, the mathematics of the world is and can only be one. [...] The cosmos of universal mathematics, the cosmos of order and measure, encloses and exhausts all knowledge. It is in itself completely autonomous; it requires no support and can acknowledge no other support than the one that it finds in itself (2000, pp. 6-7).

There are also other forms of patterns in nature besides the geometrically visible ones, such as the many other mathematical patterns that are not visible in the effective reality but play a fundamental role in the advanced mathematics of fields such as physics (Wigner, 1960) or the laws of motion which respond to the successive intervals in time. Regarding the latter, Whitehead recognized this repetitive phenomenon as the "periodicity in nature" (2011 [c. 1911]). The British philosopher and mathematician exemplified it by the rotation of the earth and the phases of the moon. Regarding the latter, Whitehead firstly described *the pattern of repetition* of light and dark phases in the sky associated with cultural and sacred aspects:

> In modern civilized life, with its artificial light, these phases [*patterns*] are of slight importance, but in ancient times, in climates where the days are burning and the skies clear, human life was apparently largely influenced by the existence of moonlight (Whitehead, 2011, pp. 164-165, own addition in brackets).

In pre-modern times, different cultures associated the patterns found in nature with the blueprint (*Bauplan*) of a designer, with a logic coming from the divine order. The patterns of ancestrality inherently contained a sacred code that the different cultures would eventually come to decipher. In this vein, God's fingerprint always remained as an unknown pattern.

> be designed; second, obedience to the designed preferences has to be secured. The first requisite calls for freedom of choice; the second spells out the limitation or total elimination of choice. Both requisites had been projected upon the image of culture (2000, p. xiv).

Deathless pattern. That is, nature and the entire cosmic universe were portrayed as *theatrum dei* in which all manifestations were embedded in sacredness (Sect., Part III, Chapter VII, § 1.). Yet, in the late modernity, these patterns were put under the light of the method of physics, chemistry and the hypotheses of biological evolution, allowing their formation to be recognized through their experimental and theoretical principles (Ball, 2016, p. 6). Still, the *mathematical science of nature*, Cassirer explained, is a return to ancestral knowledge, both Kepler and Galileo gave new meaning to the seminal ideas designed by Pythagoras, Democritus, and Plato (2000, p. 6).

The form, granularity, and regularity of patterns belong, at a greater scale, to the mathematical domain of study: “The corporeal world is subordinate without any reservation to the power of mathematical thought” (Cassirer, 2000, p. 7). There can be no doubt that mathematics is a human activity which, at the same time, can underpin most of all other human activities. Yet, under “patterns of ancestrality” we still refer to the patterns as a content itself and not to the subject that, at a later stage, based on its sense-perception and subjective experiences serves from them in order to organize its perception of reality. Of course, this falls against Kant’s ideal transcendentalism, whose schema of the cognizant subject, under structural and apodictic categories, allows organizing the experience of representation of the world (Prado, 2021, p. 17)[47]. The latter is also referred to as the “cognitive approach” to which, to a great extent, not only Kant but also Descartes and Locke belong[48] (de Freitas, et. al., 2017, p. 3). Another approach, the nominalist, regarding mathematical objects declares “that they do not exist at all, and are simply symbols or fictions” (p.3). For the latter philosophical current, it is rather language what plays the fundamental role as a means of access and as a creator of mathematical and mental reality to which the neointuicionist school belong, especially followed by Leopold Kronecker, Luitzen Brouwer, and Raymond Poincaré.

Against these two previous positions, the patterns of ancestrality hold a realist position in favor of the Pythagorean-Platonic understanding on mathematical objects whose ontological independence and force has been held later by many different philosophers and mathematicians such as: Gottfried W. Leibniz, Georg Cantor, Gottlob Frege, Kurt Gödel, Albert Lautman,

[47] I already developed this debate in my paper called: *Mathematical objects* (2021). It is not part of the proposed objective to extend here this extensive debate which occupies a large part of the epistemological debate in the history of philosophy from the 19th century onwards. For this debate, see as well, how it has been currently worked through by Meillassoux, especially in his work *After Finitude* (2008).

[48] The editors of the book *What is a mathematical concept* summarize the philosophical positions of this debate through the classification proposed by Bostock (2009): cognitive (conceptualists), realists and nominalists.

Hartely Rogers, Roger Penrose, and many others. Why does this actually matter? To say that there are "patterns of ancestry" is equivalent to claim that there are mathematical arrangements (mathematical objects) that exist independently of our (subjective) constructions and that we, sense-givers, come at a later stage to unveil them. Mathematics is the *fons et origo* of patterns. This discussion, nonetheless, exceeds the purposes of the present analyses and a great realist defense has already been worked in the book *Mathematics as a science of patterns* from Michael Resnik (1997). Henceforth, the reader is suggested to adopt a Platonic attitude in the same sense that the mathematician Hartely Rogers demands in his masterful 1963 article:

> For our purposes, for the sake of efficient communication below, we suggest that the reader adopt a platonistic attitude, simply viewing the situation, for the present anyway, as being concerned with our language on the one hand, and these independently existing mathematical objects on the other (p. 929).

As we wrote at the beginning of this work and we repeat here: the patterns are ancestral (by nature), sense-giving (by human agency), automated (by technology). The use of the adjective "ancestral" (that we intend to readapt) takes up to a large extent the sense given by the contemporary and realist French philosopher, Quentin Meillassoux [49]. Patterns of ancestrality exist independently of the activity of thought or the *cognitio experimentalis* and that is why we make use of Meillassoux's sense of the concept. Of course, only later with human sensitive perception they become, as noticed by Aristotle in *De anima*, *aisthētá*, namely, objects of perception and it is through the human development of applied equations that we are able to give an exact account of the precision of these patterns. Yet, the existence of their design, as found in nature, was fully independent of the "cartesian gravity", borrowing Daniel Dennett's terms (2018), that is, independent of the subjective point of view coming from the observer.

At the further stage, we can acknowledge through careful observation the consistency, periodicity, and regularity of the events of nature, and therefore, make experimental data feasible for verification. The first researcher to conduct a scientific investigation using methods of physical science to the study of patterns and even influencing the late period studies of Alan

[49] A note of what the term refers to, had been already outlined in the previous section. We do not intend to fill the pages with an analysis of the meaning of ancestrality in Meillassoux's philosophy, but merely to use it as a tool to fulfill our own purposes.

Turing himself was the Scottish zoologist Thompson Wentworth in his 1917 book, *On Growth and Form*[50].

> Cell and tissue, shell and bone, leaf and flower, are so many portions of matter, and it is in obedience to the laws of physics that their particles have been moved, moulded and conformed. [...] Their problems of form are in the first instance mathematical problems, their problems of growth are essentially physical problems. [...] there is no branch of mathematics, however abstract, which may not some day be applied to phenomena of the real world. (Thompson, 1942, pp. 10, 11).

In other words, it was the mathematical order that made it possible to model the patterns found in both: nature and the universe. Symmetry and regularities[51] (produced by the distinction of attributes or properties) constitute the ancestral code of nature. Following Galileo's *dictum*, nature is "scritto in simboli matematici". Notwithstanding, patterns of ancestrality do not simply make the world a more organized and predictable place; on the contrary, although they manifest an underlying ever-recursive order, they can give way to "unexpected connections" (Wigner, 1960). We can, for example, appreciate the golden ratio of a Fibonacci sequence producing the repeating spirals in plants[52], in galaxies[53], and in several others elements. Another mathematical representation such as the "Fermat's spiral" also served to model the parabolic spiral pattern of plants (the so-called phyllotaxis phenomenon) as well as certain galaxies, and

[50] Cf., Ball, 2016, pp. 6-8.

[51] This principle of regularity in patterns is mostly recognized from physics as "invariance property", which implies a generalization and simplification of events that happen not only in a particular context but in all contexts and at all times, which was, is and will be true (Wigner, 1960, p. 3). When referring to regularity, we can cite the example of Galileo:

> One such regularity, discovered by Galileo, is that two rocks, dropped at the same time from the same height, reach the ground at the same time. The laws of nature are concerned with such regularities. Galileo's regularity is a prototype of a large class of regularities (Wigner, 1960, p. 3).

[52] Besides the Fibonacci sequence, leaves can also be arranged at regular intervals of 90 degrees (basil or mint) as well as of 180 degrees (stem grasses, like bamboo) ("Mathematics of leaves", 2019).

[53] A reference in the study of planetary patterns and orbits and spheres was the mathematician and astronomer George Biddell Airy. Cf., Airy, G. B., (1887).

later applied it to many technological developments. Of course, it is also the case that many patterns lack a symmetrical mathematical formalization. Patterns are a way of rearranging information. The mathematics behind physical phenomena has been described by Eugene Wigner's famous article, "The unreasonable effectiveness of mathematics in the natural sciences", as follows: "the enormous usefulness of mathematics in the natural sciences is something bordering on the mysterious and that there is no rational explanation for it" (1960, p. 2).

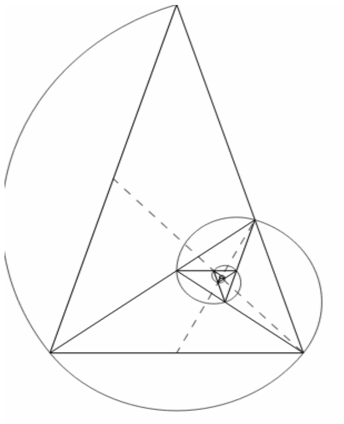

Figure 5. Pattern found in nature of a logarithmic spiral following the golden triangle and the Fibonacci sequence. Source: Wikimedia Commons, public domain.

All patterns exist to facilitate interconnectivity, distribution, and communication in the flow of information signals, namely, to minimize the entropy processes. When referring, for example, to *branching and networked patterns* of nature we find: the roots, stems and interior of plants and trees, the branching lightening of electrical discharges, the branching interconnection of rivers and streams, cracks in ice, the wings of insects, when referring to ourselves: the branching of neurons, bronchi, veins, capillaries, even our very hands and feet share the same pattern-branching, and when referring to technology: submarine communications cables that provide internet signals, electronic circuits in the chip, highways, and many others. Order offered by regularities and repetitions in patterns is *the most fundamental aspect for any living and non living system to evolve,* since from their very conception, it is through repeated patterns that a model of the world is obtained and therefore, the very prediction of future events can be derived.

Patterns prevail in nature, in animals, in humans, and in machines as well. For example, for plants[54], patterns are an efficient mechanism for growing (e.g., sunflower seeds). Against this claim, one could derive that such patterns arise from the transport of growing hormones (auxin) by proteins and understand it mainly through their organic chemical growth, yet, these plant-leaf arrangements also hidde mathematical models (although they are not sufficient for all cases)[55] to predict the repetition produced in the many leafs rearrangements. In diverse parts of his works, Simondon referred constantly to the adaptive tendencies of plants (e.g., phototropism) carrying within themselves a strong homeostasis with respect to the milieu in the face of different conditions: drought, humidity, lack of light, and others, but still, lacking of the ability to modify their relationships and therefore, their own structure (CPH, 67, 68). In the case of animals, as Simondon analyzed especially in *Perception and Modulation* (1968), instinctive behavioral patterns (inherited behaviors or perceptual stimuli about their feeding habits, repose, self-protection, copulation, and others) facilitate and increase their survival and adaptive success. And for the field of cybernetics, the patterns prevail as a key-evolving feature, particularly, with respect to the transmission of signals and message-states; these represent the function of the probability of occurrence of a series of patterns on noise. From this it is possible to derive that against the concept of pattern is that of noise. Simondon alluded in *Cours sur la communication* (1970-1971) to "noise" as a "parasite" in the following manner: "the increase of selectivity, from the receiver's point of view, allows the elimination of parasites (noise or signals coming from other sources)" (CC, 71, own translation).

Now, this first ordering of patterns in nature or patterns of ancestrality responds to a mechanism, to an automation that is later transferred to the different modes of existence, as Canguilhem, in this regard, expressed: "Thus we have come to see in the machine a fact of culture expressing itself in mechanisms that, for their part, are nothing but a fact of nature to be explained". (Canguilhem, 2008 [c. 1952], p. 92).

Patterns are the struggle to extract order from chaos. The patterns presented in plants, animals, humans and machines represent the creation of order, namely, the ever open search for perfection between the form and the function: that is, *the structure*. In this sense, the

[54] For the study of the mathematical patterns in plant growth, the following contributions have been fundamental: D'Arcy Wentworth Thompson (1917, On Growth and Form), Benoît Mandelbrot (1982, Fractal Geometry of Nature), Przemyslaw Prusinkiewicz & Aristid Lindenmayer (1990, The Algorithmic Beauty of Plants).

[55] For recent conclusions on the field: Cf., Yonekura, et. al, (2019).

technological task of automatizing mathematics continues, in a way, the ancestral pattern of evolution: "Evolution is about turning «bugs» into features, turning «noise» into «signal»" (Dennett, 2017, p. 124), we can also add, turning "attributes" into "models" (Sect., Part II). Evolution is an unfinished process of giving form, of ever in-forming by the variety of one pattern into another.

One of the first to devise a mathematical model for patterns in nature comes from Alan Turing himself with his not so well-known theory of *morphogenesis* presented in his last paper "The Chemical Basis of Morphogenesis" from 1952. Two years before putting an end to his life, he provided the first mathematical representation to understand spatial organization (formation and concentration) of morphogenetic patterns, that is to say, spots or waves in anatomic structures of the embryo (Diego, et. al., 2018). About this mathematical model, Turing himself pointed out the following: "This model will be a simplification and an idealization, and consequently a falsification" (1952, p. 5).

The patterns of ancestrality were "detached" or "liberated" from their original environment (*ursprüngliche Umwelt*) and shifted to a historical event. When?: once they were discovered, manipulated and rearranged by human and technical mediation. Once patterns were displaced from their natural environment as a divine model of explanation of the world and began to be placed under the spotlight of scientific methods, particularly by mathematical methods (which were fueled by calculating machines) the patterns triggered an *accelerated mode of reproduction*. The following, is only one example of pattern's reproductive behavior which, since Turing, became spread in many different branches:

> In 1952, Alan Turing proposed a theory of biological morphogenesis to explain the emergence of spatial organization in the embryo. The influence of this ground-breaking theory has been phenomenal, *as it has subsequently been invoked to explain patterning processes* in chemical reactions, nonlinear optical systems, semiconductor nanostructures, galaxies, predator-prey models in ecology, vegetation patterns, cardiac arrhythmias, and even crime spots in cities (Diego, et. al., 2018, own omission of in-text brackets, own italics).

The mathematical model is a universalizing expression, a network of abstract relationships that allow patterns to be identified in a way that otherwise could not be captured with the naked eye. That is to say, «mathematics as the science of patterns» (Steen, 1988, Devlin, 1994, Resnik, 1997), is the disputed field of processes and relations regarding unity and multiplicity of numbers, forms, sets, elements, functions, spaces, concepts, and its many ontologies (for Badiou, mathematics itself is an ontological field of dispute, Sect., Appendix)[56]. Mathematics are intrinsically related to the existence of patterns whether they are produced by nature itself (patterns of ancestrality), by humans through tecnics (patterns of history) or by the machines themselves (patterns of hyperhistory).

> Why does this word 'pattern' seem so apt? No doubt because it connotes order, regularity, and lawfulness. Moreover, as the pattern, say, for a shirt is not cloth but the plan, scheme, or idea for a shirt, the word «pattern» calls up the fact that, as one writer puts it (in a book called again Mathematics as a Science of Patterns (Resnik 1999), «…in mathematics the primary subject-matter is not the individual mathematical objects but rather the structures in which they are arranged» (Resnik, 1999, p. 201) (Fried, 2010).

§ 2. Patterns of history

Different patterns have given rise to different mathematical formulations. These patterns can be differentiated weather *thinking them throughout their history*[57], that is to say, the history of mathematics as such or *thinking about them through mathematics as a tool* (Fried, 2001, 2018). In the latter case, if we think of mathematics as a tool, the different types of patterns have given rise to the study of different areas. For example, those patterns related to forms and symmetries have given rise to studies in fields such as geometry, topology, calculus, analysis, and algebra. When dealing with examples such as population distribution, demographic dynamics and behavior changes (birth, death, migration), the patterns are understood through mathematical theories of differential equations, calculus, and statistics. When numbers are arranged in a sequence that follows a pattern/rule, the deduction of the next number belonging to a series can encompass algebraic or arithmetic patterns, geometric patterns, and for example, the already mentioned, Fibonacci pattern. Prognosis of the probability of an event occurring by

[56] Badiou, A. (2006).

[57] Mathematics "a science of patterns" (Steen, 1988) can be understood weather as the root of reality in its timeless and transcendental aspect or as a historical entity (Fried, 2001 in Fried, 2010) embodying diverse modes of thought (Sinclair in Radford, 2014, p. 90).

causal interrelation or correlation (independent or not) between variables leads to studies in probabilities and statistics.

In the former case, from a historical perspective of mathematics, it is from the 17th century, with the beginning of modernity, that pattern-thinking began to be identified as the very mark of modern mathematics, especially through Descartes and Leibniz. This is algebra's generalization of arithmetic. The algebraic abstraction of patterns were no longer to be found in the bare visible geometric figures[58] [59] of nature but also in abstract symbols hiding the unknown, the "indeterminate" (*incertorum*) as called by Leibniz. Purely symbolic expressions broke away from the visual intuition for patterns. Since the influence of Descartes, abstract symbolic expressions like x^2-y^2=k no longer needed to be in correspondence with geometric figures and their particular points (Fried, 2010). In the same way, in 1958, the philosopher Ortega y Gasset also recognized that under the algebraic symbol x "all numbers can be that any" (1958, p. 20). As Simondon remarked: "Rational mechanics introduced machines into the domain of mathematical thought: Descartes calculated the transformations of movement within the simple machines used by the slaves of antiquity" (MEOT, 105). Simondon concluded (in a Kantian sense) that the liberation of machines from their status of use (minority) and their entry into the reflexive status (majority) were brought about through the rationalization of machines, which at the same time, enabled their entrance into Culture (Sect., Part I).

Following this trace, Oswald Spengler, the German author of the early twentieth century that predicted the decline of the West, made a profound study of culture and mathematics. He divided mathematics according to the type of culture; major cultures (Classical and Western) and minor cultures (Babylonian-Egyptian), (Arabic-Islamic), (India, China) (Restivo, 1992, p. 6). As Sal Restivo notes, following Spengler, in classical culture there was the Pythagorean conception of number as a "magnitude", that is, the measurement and proportions of visible bodies according to a scale of positive and whole numbers. This was complemented, in turn,

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58 We can note that during the pre-modern period the patterns of the visible world were commensurable magnitudes that corresponded to the formulation of mathematical abstractions. From its Pythagorean bases, reality consisted of a harmonic cosmos offered by relations between whole numbers. This is true to the point that the rupture of the harmonic cosmos through the discovery of irrational numbers led to the collapse of the Pythagorean School.

59 Resnik, from its self-confessed realism, however, accounts for the daily relationship between the elements manipulated in experience and the construction of mathematical objects from them: "I hypothesize that using concretely written diagrams to represent and design patterned objects, such as temples, bounded fields, and carts, eventually led our mathematical ancestors to posit geometric objects as sui generis" (1997, p. 5).

with the contributions of: Plato, Archytas, and Eudoxus, and later, Euclid Apollonius, and Archimedes. But it is from the middle of the seventeenth century when the number was no longer found as a magnitude but as a "relation" brought by the contributions of: Descartes, Pascal, Fermat, Newton, Leibniz (1992, p. 6). This event was further deepened in the eighteenth century by Euler, Lagrange, and Laplace and completed in the nineteenth century[60] by Gauss, Cauchy, and Riemann (p. 6). Restivo writes: "Western mathematics liberates geometry from the visual and algebra from magnitude" (1992, p. 7).

The focus in mathematics would no longer be, as ancient Greeks did, only submitted to begin with concrete mathematical objects from the actual world (e.g., a circle) to prove then their individual properties (Fried, 2010), rather mathematics began to drive in modernity towards their rearrangements and structures, that is to say, towards its relations: "A mathematics that looks at patterns rather than individual properties of individual mathematical objects was what Descartes' sought in *mathesis universalis,* «universal mathematics», which he associated with the then new subject of algebra" (Fried, 2010)[61].

Mathematics (beyond its ontological premises) is a human activity and so is culture, both of which are, in turn, symbolic activities. As modernity advances, we no longer find an exact fidelity of thought to reality or, in other words, the visible structure of reality no longer seems to reflect the symbolic potentiality of thought. Mathematics long before, and then cultural philosophy much later, would thus become symbols-suitable fields par excellence, one related to numerical and operating symbols, and the other related to the potentiality of acquiring meaning and sense beyond the symbolic cultural expressions themselves. This event has been much later identified by Ernst Cassirer, to the detriment of Kantian philosophy: reason was not

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[60] Lautman has distinguished, in mathematics starting from the 19th century, the former (assemblage of elements) as "the local point of view" and the latter (the function or operation played by elements) as "the global point of view". He then applied these categories for the theory of analytic functions, geometry and differential equations. Cf., Lautman, A. (2011), particularly in Chapter I: "The local and the global", pp. 87-137.

[61] With the new image of the world as *mathesis universalis,* Galileo, revives a Pythagorean thesis: reality is, in its depth, a numerical reality where everything succeeded in entering into the order of the mathematical language. Ortega y Gasset brilliantly explained:

> The Galilean "way of thinking", to which Galileo had to be faithful, is the one that, in the most prodigiously clear way, enunciates his definition of the new science, which was to consist of "measuring everything that can be measured and making measurable what cannot be measured directly" (1958, p. 10).

a sufficient variable to understand cultural expressions in all its rich and polysemic dimensions, culture itself implies a *symbolic world*. In this modern sense, there is no human agency free of symbolization: everything is subject to the symbol and everything derives from it.

In the mid-19th century, the *propositional calculus* of boolean algebra marked the beginning of the symbolic realm and therefore the genesis of digital logic[62] used today in the logic gates of computer chips. The reticular nature of the data coming from the possible logical combinations of the "universe of discourse" (1) and the "empty universe or set" (0) gave way to a digital environment whose underlying binary digits are none but patterns stored and computed. These symbolic patterns are finite realities broken down to the infinity (Sect., Appendix, §2., 2.1.). The traces of Boolean algebra of classes were formalized in electronic logic circuits thanks to Augustus de Morgan-De Morgan's theorem. This 19th century mathematics was embodied in the so-called "Von Neumann architecture"[63], which is similar to today's computer processing architecture.

With the beginning of mathematical logic around the middle of the 19th century, the symbolic order of thinking fostered by the Boolean logic and first-order logic scenario (initiated by Gottlob Frege) gave rise to the truly first convergence of the laws of thought and calculation. This epistemological upheaval turned away a significant proportion of knowledge based on the intuitions of human thoughts and started to focus on mind's symbolic operations: "The middle of the nineteenth century, which had exercised the demon of intuition from knowledge of the real and posited the formalization of an unrepresentable reality" (Hörl, 2018, p. 111).

It was significantly in the late 19th century when it was equally admissible that mathematical logic (e.g. Boole's algebra, Cantor's set theory, first order logic, non-euclidean geometry)[64] so as the physical field theory (e.g. electromagnetic field, statistical mechanics, quantum theory)[65] detached from philosophical or speculative thinking, since, principles no

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[62] In digital logic, this construction from Boolean algebra was necessary for the design of digital circuits (actually, this is said in a very rough manner since electronic logic circuits are not directly indebted to Boole but to Augustus de Morgan-De Morgan's theorem). See Morgan references in: O'Neill, J. (1993).

[63] See, the footnotes 74 and 75 of this chapter where it is explained that this is *not* historically mainly attributable to Von Neumann, but that, popularly, this architecture has been recognized under his name after an initial paper.

[64] It is still important to notice that Frege, the father of first order logic, was still in favor of concepts and intensions (Walicki, 2012, p. 18).

[65] This view opened a non-deterministic and objective-dynamic framework gifted to humanity thanks to the enormous contribution of the austrian physicist Ludwig Boltzmann (1844-1906) by his introduction of probabilistic analysis in the field of physics, a new field from then called: *statistical mechanics*. The accuracy to

longer needed to be representative of the real (*real Sein*) neither supported by their nature in order to be formalized. Effacing that necessity, warned by Nancy as the "technical displacement of ontology"[66] or by Hörl as "the nonrepresentability of Being"[67], the scenario for a new type of non-representational unity was on the rise. The order of the extensive and the calculable thus entered an un-representable reality that required a new type of metaphysics and epistemological formality which were no longer based on concrete substances (substantialist metaphysical principles). This was a call for a processed-based (ontogenetic) metaphysics (Simondon) and relational-based epistemology (Bachelard).

Now, what we call «patterns of history» implies the very explicit human agency able to modify the relation of patterns found exclusively in nature in order to give rise to new patterns, particularly, by means of technological intervention. We shall now pay attention to the moment when the pattern "escapes", in a certain way, from human mediation and begins to be automated by programmable machines in the next section.

One of the ways to manually reproduce patterns is by designing them on fabric, for example by painting or weaving. In this way, patterns, initially, had to be mostly weaved line by line by hand embroidery. To weave patterns with hands is to be an artisan which equals seeking the mechanisms of imitation of nature, namely, the mechanisms of *creation of form.* Simondon expressed this at a great philosophical level:

> The machine cannot retain forms, but merely a translation of forms, by means of an encoding in a spatial or temporal distribution [...]
> In human memory, on the contrary, it is the form that is preserved: preservation itself is only a limited aspect of memory, which is the power of selecting forms, of schematizing experience [...] The plasticity in the memory of machines is that

reach a fuzzy unitary nature could only occur not through deterministic laws of nature or selbst-probative philosophical schemas but through a principle that didn't even need mathematical formulas to be proven, in fact the only element to verify it is *time*: the mere configuration (distribution) of particular states in time which will always tend to its maximal configurations (normally recognized as "disorder"). Boltzmann, still without the formal acceptance from the scientific community of the existence of atoms, introduced a quantifier called "entropy" (S) of possible configurations from particular gathered data. The entropy is a way to measure the combination of possible configurations of a particular state. This principle, openly rejected by his colleagues during all Boltzmann's life, was only recognized after his suicide and applied by Max Planck under the formula: $S= K \ln W$. Boltzmann's breakthrough in the field of physics depicted the prelude of quantum mechanics.

66 Nancy, J. L. (2018, p. 14).

67 Hörl, E. (2018, p. 114).

of the medium, whereas in human memory it is the plasticity of the content itself (MEOT, 136, 137).

Let us remember one of Simondon's greatest influences, Henri Bergson, who remarkably also recognized this very fact:

> We are born artisans as we are born geometricians, and indeed we are geometricians only because we are artisans. [...] Whether nature be conceived as an immense machine regulated by mathematical laws, or as the realization of a plan, these two ways of regarding it are only the consummation of two tendencies of mind which are complementary to each other, and which have their origin in the same vital necessities [...].
> In so far as we are geometricians, then, we reject the unforeseeable [...]. Long before being artists, we are artisans; *and all fabrication,* however rudimentary, *lives on likeness and repetition,* like the natural geometry which serves as its fulcrum. Fabrication works on models which it sets out to reproduce; and even when it invents, it proceeds, or imagines itself to proceed, by a new arrangement of elements already known. Its principle is that «we must have like to produce like» (Bergson, 1944 [c. 1911], pp. 51, 52, own italics).

At this point we ought to evoke that for Simondon the birth of the machine as what he called the "technical individual" originates with the displacement of the artisan/craftsman. This displacement of the human as pattern-maker by the technical individuals (e.g., weaving machine), in truth, does not exactly imply a displacement but an accommodation to its place of origin (a re-position, a re-location): "The machine thus takes the place of man because, as tool bearer, man used to do the job the machine now does" (MEOT, 21) wrote Simondon. The quest to occupy the existential arena of how to recognize and reproduce patterns out-of-nature and by automated means began with the creation of *punch cards.* That was the time when, *for the very first time, the patterns became meaningful to the machine* at the dawn of the 19th century.

2.1. The automation of patterns by programmable machines

The place of choice to analyze the technological automation of patterns and their increasing reproduction begins with the punch cards of the mechanical loom brought to perfection by the French merchant Joseph Marie Jacquard in 1801, its german translation exposes the importance of patterns in this machine: *die Jacquard-Musterwebmaschine*. This programmable machine automated patterns for the first time in history and became the starting-point for the two landmark cases in the history of data processing: first, Herman Hollerith's *punched card* tabulating machine (1884) which was use for 1890's US census and whose company, CTR (Computing-Tabulating-Recording Company) had been later renamed IBM (International Business Machines Corporation), and second, the prime and unbuilt mechanical general-purpose computer, *The Analytical Engine* (1937) whose aim was to compute mathematical and astronomical tables. While the latter was thought to use a decimal numeral system and cards interlocked (strung) with each other (like the loom), the former was a mechanized binary code whose cards were not interconnected to each other, but rather, each card had to be placed under the needles so that when going through the holes, they could be immersed in mercury, the contact of needles with the mercury would then allow an electrical contact that functioned as a counter, and those parts of the card without holes would act as insulators. The potentiality of both of these systems was the way in which punched-cards controlled and automated the patterns.

The patterns, initially automated by the mechanical loom, were designed on the punched cards (each card represents a line) which had to be strung together, the holes of the cards were pierced by needles allowing the superposition of warp threads, some warp threads got up while others remained in their place to form the design of the pattern:

> The loom would read the arrangement of holes punched on a card with a lattice of spring-activated pins connected to hooks that would each individually lift a warp thread wherever a pin entered a hole. In this way, the loom could be programmed, and patterns could be modified or switched by rearranging or replacing the card deck (Keats, 2009).

It is no coincidence that with the first programmable machine Simondon identified the birth of the *complete technical individual*: "Man's frustration starts with the machine that replaces man, with the automatic weaving loom" (MEOT, 131) and also defined, much later in other work, the pattern along with the weaving process: “pattern = patron - (*en couture*) to weave - modèle” (PM, 220, own translation). As remarked, these punched cards containing the designed pattern were the inspiration of Babbage’s Analytical Engine. In the latter case, its cards were of two types: “operational cards” to enter the instructions and “variable cards” to enter the data. What did these mathematical tables of operations and variables represent? Once settled, the primary goal of computer programming in the punched-card era was to print mathematical tables for its multiple and diverse uses, such as, to standardize items “from shoelaces to missile parts” (IBM, 1994, 2022). In other words, executing long computations automatically was the new way for the emergence of patterns.

In 1941 took place the first programmable computer (Z3) followed later by the first high-level programming language (*Plankalkül*) both being Konrad Zuse’s achievements, the following year the first electronic computer, ABC (Atanasoff–Berry computer) using magnetic drum as working memory was presented. In this context, Howard Aiken’s machine (1944) called the Mark I, fulfilled the initial goal of automatically computing a massive amount of mathematical tables, in other words, it fulfilled Babbage’s goal, thus becoming along with Zuse’s machine the first universal machines not depending on Turing’s notion of a universal machine (Daylight, 2012, pp. 1, 2).

As we wrote, the analytical engine’s goals as fulfilled by the 1937’s IBM controlled calculator, Mark I at Harvard, was designed by Howard Aiken and run later on Von Neuman’s program. Its functions were still punched into a tape: “Numerical input was in the form of punched cards, paper tape or manually set switches. The output was printed by electric typewriters or punched into cards. Sequencing of operations was accomplished by a perforated tape” (IBM, 1994, 2022). During the same year a machine using Boolean Logic for complex calculations called, Complex Number Calculator, was released (Gere, 2008, p. 43). All of this depicts the fact that the digital data processing industry (recording, storing, and analyzing data) had its origin in the design of tangible patterns occupying predefined positions in space together with the functioning of tabulating machinery.

Each card is equal to a line of code and each card stores, as we have already said, not only data but also programs (instructions) belonging to a programming language (at that time, for example: Algol, Fortran, and others). In other words, an entire program was equivalent to a very large deck of punch cards. Conventions vary by computer architecture. For most purposes, the computers that read these punched cards (e.g., ENIAC) had a specialized circuitry in the card reader and a standard method (e.g., ASCII, EBCDIC, Unicode) that allowed them to recognize characters in the presence (representing 1) or absence (representing 0) of the hole.

Storing characters required the pattern recognition of bites. Each character was encoded in 24-bit sized data with four 6-bit characters and not with 32-bit words with four 8-bit characters as it is the case in the register and natural arithmetic width of today's computers.

We had mentioned in the section called "patterns of ancestry" (Sect., § 1) that patterns got "detached" or "liberated" from the geometrical figures of the visible world when they became abstracted by the formalization of the mathematical symbols, i.e., the dissociation of geometry in the mathematical notion of "function". This "liberation" did not occur all at once but was prolonged as mathematical structures were developed, becoming more abstract and giving rise in the late 19th century also to the interest in the concept of the *infinite* (Sect., Appendix, Chapter IX, §2.). The increasing abstraction also allowed a series of events that would lead to the historical passage of the patterns, where not only the relation between symbols has been developed through the application of algebra (for mathematical purposes only), but also later, it would be completed in mid-1938 with the application of Boolean algebra to the electronic circuit. Boolean algebra initially also had only mathematical and clearly non-computational purposes, involving the translation of logical forms into mathematical forms expressed in symbols and operations. But it was with the application of Boole's logic to electronic circuits what allowed a reliable transmission of information able to overcome the noise.

In his 1937 master's thesis at MIT, Claude Shannon applied Boolean algebra and thereby founded the theory for the design of digital circuits. Also, in his 1948's paper, "A Mathematical Theory of Communication", Shannon brought to light the field of *Information Theory*[68]. Without Shannon, the very idea of patterns could not have flourished, the techniques of data compression, signal design and optimization have their very foundation there. As Yuk Hui argues: "The notion of information has evolved since the 1940s, i.e. since the publication of Claude Shannon's Theory of Information" (2015, p. 30, own translation). The basic idea to mathematize the information was based on isolating the limit of communication with a given noise, i.e., the number of bits per unit time that could be transmitted over a given bandwidth. The message was thus associated with a certain degree of probability and recognized as a "bit", the basic unit of uncertainty. A physical system, or a mathematical model of a system which produces such a sequence of symbols became governed by a set of probabilities, known as a

[68] Cf., Part I, Chapter III, §1.. for the debate that Simondon engaged in with respect to Shannon's notion of information.

stochastic process[69]. The pattern could be reproduced through the notion of "bits" at a greater speed with the end of Babagge's mechanical or pre-electronic era and the beginning of the electro-mechanical era implemented in relays and switching circuits until the 1950s.

It took about three decades until data storage technology moved completely away from the use of punched cards towards *magnetic storage* and from relays to *vacuum tubes*. Magnetic memory can be found on the range of magnetic drums, magnetic core-memory, magnetic tape (plastic-based)[70], and also magnetic disks. The early computers of the mid-forties and late fifties made use of magnetic tapes for commercial use, the first and most well-known example is the UNIVAC[71] (the Universal Automatic Computers) whose energy flow was controlled by 5,400 vacuum tubes (these were the devices that, for example, Norbert Wiener was familiar with). Pattern storage/recognition evolved through how the flow of electric current could selectively direct the magnetization in the material in order to store/recognize the 1 and 0s. Although the evolution of magnetic recording was initiated with the telegraph (conversion of sound wave patterns into electrical signal voltage) it derived in the UNIVAC computer (conversion of electrical signal patterns into thermal energy).

Around the mid-forties, a new generation of computers (starting with the EDVAC - Electronic Discrete Variable Computer) became digital electronic computers with stored programs[72] using alphabetic characters and Boole's algebra. In the famous Newell and Simon's paper of symbolic AI from 1975, they noted:

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[69] And despite the rigor of "information" as a purely syntactic expression (Shannon (1948), Shannon and Weaver 1949) the notion of "information" has become "elusive" as Floridi (2011) characterizes it, not only in its analytical-auxiliary but also in its empirical-synthetic aspect as distinguished by Carnap (1937) (D'Agostino, 2019, pp. 164-180).

[70] It first appeared as magnetic wire recording, the support of steel wire evolved later to cellulose tape, and in 1934, to plastic where magnetic tape went into the market, initially for musical purposes.

[71] It is necessary to recognize previously (1949) the development of the E.D.S.A.C that also stored its program and of B.I.N.A.C that was developed in parallel with the UNIVAC.

[72] The recording and pattern recognition depends on the tape format but in general, we can address,, in principle, that it is due to the material of which the tape is made in combination with the head, i.e. the tape must be coated with an easily magnetizable material (e.g. iron oxide). Magnetization implies that there is a process of separation of the electromagnetic field that indicates the position of the bits to the head, which is responsible for reading or writing the data on it.

> With the development of the second generation of electronic machines in the mid-forties (after the ENIAC[73]) came the stored program concept. This was rightfully hailed as a milestone, both conceptually and practically. Programs now can be data, and can be operated on as data. This capability is, of course, already implicit in the model of Turing: the descriptions are on the very same tape as the data (p. 117).

While the construction of the ENIAC (1945) did not contain *data storage* in its early days, it was fundamental to solve extensive numerical problems beyond calculating ballistic tables (as opposed to previous designs), namely, it was the practical beginning of general purpose digital computing. The stored-program idea belongs primarily to John von Neumann (although this is historically discussed by Copeland (2020)[74] and by Russell (2020)[75]) who, in 1952, created the EDVAC and whose program was already in the internal memory before execution. What utterly mattered is that beyond the recognition of bits on the tape, what had to evolve was the storage of the data in the memory of the program itself rather than on the tape. This was the very moment of the evolution of electronics. As Gere (2008) explains: "The solution was to store data internally, in electronic form" (p. 46) which led to the release of the first digital electronic computer in the modern sense, the already mentioned, Manchester Mark 1 based on von Neumann's architecture[76] (its commercial version is known under the name of Ferranti Mark 1):

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[73] The ENIAC or ASCC, unlike the EDVAC, did not treat program instructions as data to be processed. The EDVAC distinguished itself not only by treating programs as data in internal memory but also by encoding them in binary.

[74] In this vein, Copeland clarifies:

> Von Neumann was a prestigious figure and he made the concept of a high-speed stored-program digital computer widely known through his writings and public addresses. As a result of his high profile in the field, it became customary, although historically inappropriate, to refer to electronic stored-program digital computers as 'von Neumann machines' (Copeland, 2020).

[75] As Russell Stuart explains this architecture was not invented by von Neumann himself but his name was part of an early draft dsecribing the EDVAC stored-program computer (2020, p. 301).

[76] This architecture has its roots back to Babbage's Analytical Engine. Cf., Bromley, A. (1982); Copeland, B.J. & Sommaruga, G. (2015).

> The simultaneous development of the Manchester Mk 1 and the ENIAC marks the beginning of the digital age, in that they are the first computers in the modern sense: digital, binary machines capable of storing data and being reconfigured to undertake different tasks (Gere, 2008, p. 50).

The stored program concept made pattern recognition a revolutionary event together with the fact that more data could be stored at a lower cost. The US census that used an electric counting machine in 1890, towards the second half of the 20th century, thanks to the UNIVAC, was then able to associate, as never before in its history, the largest amount of population data. With the data came the prediction. The UNIVAC was also the first computer to predict President Eisenhower's victory (1952) with an error rate of 1 percent. Regarding the UNIVAC computer, it was possible, as, "one paper noted, [to] «classify an average citizen as to sex marital status, education, residence, age group, birthplace, employment, income and a dozen other classifications»" (Lane, 2009, p. 137, own addition in brackets). Nonetheless, before 1950, information processing was very limited due to two factors recognized by Russell and Norvig (2010): on the one hand, the primitive state of computers (limited speed and memory) and on the other hand, the not very accessible syntax to write the instructions of the programs (assembler language) which prevented the advance of many great ideas from being simultaneously implemented[77].

In the midst of this, vacuum tubes and relays were left aside to be replaced by solid-state devices such as *transistors* in 1947 by Bell Labs and in 1954 as announced by IBM. In 1956, the tape was eventually left behind by a lower-density storage: the hard disks of the IBM 305 RAMAC or IBM 350 computer (as part of the latter). Hard disks, as different to tapes, did have random-access to data, this means they were able to access any item at random, and its patterns of bits were no longer recognized only in a *sequential manner* which implied that the computer had to finish an operation to start another one. Storage methods have not evolved through the replacement of one by another, but evolved as their methods, architectures and overall infrastructure became more sophisticated and interrelated. That is why, despite the advent of the hard disk, magnetic tape was later used in various installations based on magnetic tape cartridges, such as the so-called "tape libraries" which can also be highly superior to the hard drive.

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[77] For example, the self-replicating machines, already conceived by Von Neumann *(Universal Constructor)* in the 1940s.

Throughout the following decades, the hard-disks stored more data using magnetic, electrical, optical, and other methods of data-preservation. Between the 1950s and 1970s, hard drives were widely used by government agencies, universities, and large corporations. The market control of their computer *mainframes* (one processor shared by many individuals), at that time, was held by IBM. It was precisely within IBM that Edgard Codd in 1970 initiated the modern use of structured databases recognized through the name *relational data model* along with the development of structured query language (SQL). As Kelleher & Tierney write:

> The relational data model enabled users to extract data from a database using simple queries that defined what data the user wanted without requiring the user to worry about the underlying structure of the data or where they were physically stored (2018, p. 7).

Likewise, the sixties and seventies corresponded to a historical shift in computation that led, on the one side, to the aforementioned replacement of vacuum tubes by semiconductors, the material upon which, the integrated circuits (ICs) are made, and on the other side, the possibility to run most of the programs without having to program them every time they were to be used. Since then, data-storage evolution was all about increasing the processor performance according to the semiconductor's designs, notably expressed in Moore's Law (which shortly described implies *that* the number of transistors on an integrated circuit doubles about every two years). It was not until the sixties (IBM models 162, 1401, 1094 and NCR GE 304), when computers were gradually introduced in more corporations, yet, its integrated circuits (IC) were still fairly expensive to produce. This is due to the fact that early personal computers lacked a *microprocessor*, that is, of instructions (processing logic and control) integrated in its IC added to the fact that data-analysis was becoming increasingly difficult since the data was stored in many databases within one company (Kelleher & Tierney, 2018, p. 8).

Moving to the 1970s, the transistor reached a great potential through the invention of the Intel microprocessor founded by the creator of the recently mentioned Moore's law (Gordon Moore) and the co-inventor of the integrated circuit (Robert Noyce). This implied something critical: less use of energy and space, and therefore, an effective-cost production which was fundamental for the massive production and distribution of personal computers. The idea of computers for personal use (namely, many integrated circuits on a silicon chip) began to be extended in the 1980s by the so-called "cyber-culture"[78]. Personal computers[79] implied friendly graphical user interfaces and smooth control by the mouse which allowed any user to use the computer without the need to learn the syntax behind programming (Alpaydin, 2021). Towards the end of the 1980s, the most profitable type of memory at present entered the market: the flash memory, thus succeeding the hard disk. In addition to the large mainframe computer storage (also known merely as *mainframe*) used by governments and companies, other storage methods for personal use began to appear on the market in the 1990s, using mostly flash memory but also hard disk, such as: CompactFlash, DVD, Compact Disc-ReWritable (CD-RW), Microdrives (with capacity of 170 MB and 340 MB).

Precisely, from the 1970s onwards is a period marked not only by the very beginning of personal computers, but for the further advancement, in the eighties, nineties and noughties of computing distribution to an unprecedented level. The 1980s is marked, according to Stuart Russell, as the time when the machine ceases to be conceived in society as a question-answering product of getting its inputs from punch cards and begins to be finally perceived as *agents* (2020, p. 64). These are the previous steps of what was necessary for machine learning to occur, namely, the development of a single integrated circuit combining billions of transistors: VLSI (very large-scale integration) and the possibility to store and analyze data from diverse and numerous databases not belonging to one organization but across the organization (*data warehouses* which is not equivalent but can be complementary to *big data* open sources such as Hadoop and other NoSQL platforms).

Parallel computation and very-large scale processors from the 1980s, such as the ST-506 and ST-412 hard drives, implied advances in miniaturization: hard drives got smaller, stored more data, and became less expensive together with the already mentioned invention of microprocessors and integrated circuits and the evolution of modern structured databases (SQL)

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[78] Prior to the spread of the Internet in the late seventies, there was already a whole computational culture or subculture, as Gere (2008) points out, propitiated by the ideas and emergence of counter-culture and the hacker-culture within the context of neoliberal capitalism, both based on ideas of self-regulation coming from the market and semiconductor machines whose mecca was placed in Silicon Valley. By the 1980s, computational culture was already beginning to permeate mainstream media through cyberpunk culture icons which integrated elements referring to artificial intelligence, disruptive technologies and futuristic cities as in Ridley Scott's film, Blade Runner (1982), William Gibson's novel Neuromancer (1984), anime such as Megazone (1985), Black Magic M-66 and Wicked City (1987) and all those dystopian aesthetics that prefigured the social imaginary towards a technologically permeated future.

[79] The peak of mass-market consumer came in 1971 with the Kenbak-1 as well as in 1983 with the RO352 computer designed by the Rodime company, and many others.

towards the generation of new NoSQL databases. This created the path for the development in the 2000s of multiple servers capable of processing, integrating and combining large volumes of data (at petabyte scale followed by exabyte and zettabyte scales) from several different sources for data analysis. This is known as *High-performance computing* (HPC). They are recognized under names such as: relational database management system, operational data store, massively parallel processing database, and others. This led to the proper advancement of the traditional data warehouses that used centric relational databases technologies towards the implementation of modern, scale-out big data architectures. When working with *big data*[80] this is recognized as cluster-computing frameworks, distributed computing and storage platforms, the combination of open source data management and advanced analytics, and others. Big data's technology innovations include: the Hadoop data-processing framework, MapReduce, NoSQL, Google Cloud BigQuery, Databricks Lakehouse Platform, Cloudera, and Hortonworks Data Platform to name some of their many breakthroughs[81].

These new data-processing frameworks are scale-out architectures no longer operating with traditional relational databases but with the organization of massive amounts of data: "dark data, unstructured data, real-time access [data]" (Schmarzo, 2013, p. xx, own bracketing with addition). This also implied progress in the development of predictive analytics, programs and algorithms requiring thousands of processors, namely, scale-out processing nodes in order to compute effectively.

One of the still evolving-algorithms relying upon data-processing frameworks is the well-known artificial neural network (an algorithmic model from machine learning). The use of such processors allows the performance of matrix calculations at unprecedented speed. Precisely, a neural network is a large number of interconnected *processing units* arranged as layers (input layer, hidden layer, output layer) (IBM, 2021). The "layer" means the organization of a processing unit whose structure will depend on how the processor is programmed. In order to sort data and execute code more efficiently all its processing units shall run *in parallel.* This

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[80] Some authors such as Bill Schmarzo (2013) point out that big data, rather than revolutionizing or becoming a disruptive technological factor, was rather a revolutionary phenomenon at the business level. Towards the end of the 1980s, what is known as BI (Business Intelligence) was born. This, combined with data science, was able to merge innovation technologies (big data infrastructure) into a revolution in the value creation process chain. This resulted in the generation of new business applications (such as Amazon's models) that would have been inconceivable in the past (Schmarzo, 2013, p. 20).

[81] Schmarzo names the following examples of open source initiatives: "Google (Big Table), Yahoo! (Hadoop), and Facebook (Hive and HBase), as well as universities (like Stanford, UC Irvine, and MIT)" (2013, p. 2).

means that multiple processors (computers) can execute the same task (e.g., by means of: clusters, massively parallel processing databases, and grids) or a single computer can have multiple processing elements (multi-core and multi-processor computers). This opened up the possibility to handle simultaneously either the same task on different data (SIMD, single instruction, multiple data) or different tasks on different data (MIMD, multiple instruction, multiple data), and therefore, reduce the time to run the program. The whole history of data-storage and data-processing is but the result of an efficient route of pattern recognition techniques able to save time-space consumption at hardware and software levels (Sect., Part II).

Only through the spread of the Internet[82] [83] is it possible to appreciate the significant role of storage and processing information and how it is amplified towards information transfer and therefore, interconnectivity. With the first practical implementations of the Internet for personal use, the storage and recognition of patterns for technological evolution were no longer submitted to individual structures but to entire ecosystems. The machine (hardware, computing and information processing capacity) had begun to lose the "machine-form" and was heading towards the "advent of a networked structure" (Hörl, 2015, p. 3). All of these storage digital technologies (but also analogs) belong to the general production of *grammatization*, which is, what Bernard Stiegler called "tertiary retentions", "retentional technologies" and "mnemotechnolgoies", namely: "a prosthesis of exteriorized memory" (Stiegler, 2009, p. 54). Tertiary retentions entails: objectified, discretized deposited, and materialized expressions of knowledge that are transmissible, inheritable and adoptable but also have access to pre-individual funds of *psychic and collective individuation* (Stiegler, 2011, pp. 117-118).

A highly developed technical-system, like our age of peta/exa/zetta bytes of data, is a system of tertiary retentions and such supports constitute *milieus* (Stiegler, 2014, pp. 31-38). In other words, in the course of the evolution of processors, a deep becoming of grammatization processes takes place. The question of technics becomes the question of tertiary retention

[82] ARPANET (*Advanced Research Projects Agency Network*, a project that began in the sixties mainly run by MIT and the U.S. Air Force) was the first network to implement the TCP/IP protocol which is still in use today. Through the Internet Message Processor (IMP), each host computer, or node, would have an IMP working between it and the network (Banks, 2008, p. 5). In this way, the existence of the network of networks was publicly established. According to one of the most distinguished figures of ARPANET, Leonard Kleinrock: "that was the first breath of life that the Internet took" (Banks, 2008, p. 1).

[83] This is also the time where *softbots* became a new playground for AI operating entirely on the software environment such as the Web (Russell, 2020, p. 64).

(Stiegler, 2014, p. 50). This retentional and environmental state of machines implies that there are more machines than humans connected to the Internet, as has been the case since 2008. But in addition, this environmentality implies something much more relevant: a sensory-perceptual access (even reaching *situational awareness*) and distributed control over the world at an unknown level (Russell, 2020, p. 65). Such an access to the world by machines can also encourage the integration of different information systems towards updated models or what military forces refer to as *"common operational picture"* (p. 69).

The 1990s had been precisely called "the decade of probability" by Jordan & Russell (1999) and described as the "digital turn of 1993" by Stiegler himself (2015) or as the "era of access" by Sadin (2018 [c. 2016]). A shift had to occur, as computational techniques were subsequently developed and combined, in order to rearrange and give form to the increasing and large-scale abstract structures of data. When the networked connectivity (internet) took place, infrastructural and computational engineers had to lower the cost of storage capacity, improve the bandwidth, process raw data, improve the architecture of the database, allow scalability and multi-tenancy from any point and any moment, thus giving place to more detailed architectures and representation of data: data silos, data lakes, cloud data storage, and the like.

Along with parallel and massive parallel computing of the 2000s emerged the further application of more sophisticated algorithms that were designed by the end of the 80s and became the kernel of many machine learning applications. One of the central deep learning algorithms is the well-known *Backpropagation* which was initially discovered in 1969 by Bryson and Ho and, its applied method, was anticipated by Paul Werbos in 1974, and was finally successfully applied by David Rumelhart in 1986. The same method was applied in the late 80s for convolutional neural networks[84] reaching the most successful results in 2010. Between the year 2010 and 2012, machine learning reached its climax and became largely known by the media: the contemporary pioneers of machine learning; Geoffrey Hinton, Yoshua Bengio and Yann LeCun together with the Google Brain research team obtained by that time the most successful applications in artificial neural networks (Chollet & Allair, 2018; Prado, 2021) which implied 16,000 processors and more than one billion connections.

[84] The 1989 paper represented by LeCun already contains a first prototype of what will be the first convolutional neural network. With artificial convolutional networks, deep learning goes from theory to practice. His first successful application, known as LeNet in 1998, was carried out on pattern recognition of large-scale handwritten digit recognition. Cf., Le Cun et al., (1989).

Patterns symbolize the liminal passage from data to knowledge. The pattern is a result of relations between data, it is the final form of data in-context. The evolution of the computational pattern thus always depends on the conservation and manipulation of data through a program or algorithm which, taken to machine learning's case, depends on optimizing prediction. The clearest evolutionary leap of the patterns of history took place, as described previously, from a magnetic medium program to a digital medium program: precisely, the passage of database representation by magnetic storage media from tapes or disks to the digital representation of databases.

Small databases are generally stored on file systems while large databases (used for machine learning) are hosted on computer clusters or cloud storage. As the database grows, so does the pattern. Both the Internet and the infrastructures to which it gives rise, such as Cloud Computing or the Internet of Things (IoT), correspond to network architectures that create a new domain of reality which transcend the human capacity to organize space[85] [86]: "The industrial revolution created a world of centralization and organized hierarchy. Its defining pattern was a single central point to which all threads led. But the emerging digital age is different" (Ryan, 2010, p. 7).

This new distributed and interrelated map of the digital environment would serve as the *Umwelt*, the environment of algorithmic mediations. In this context many events took place: the *Conference on Neural Information Processing Systems* (NIPS) while boosting artificial neural network's underpinnings around the early nineties. For example, there were successful applications of artificial neural networks such as *LeNet* for recognition of handwritten digits

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[85] Some distinctions must be made in this regard, what is particularly decentralized are the infrastructures in charge of transmitting the information packets together with their wide and unrestricted access to the network servers, but the "control points", taking up the concept of Buzai, G. (2014) geographical as well as the data storage centers (data center) do not correspond to horizontal infrastructures but right to the opposite. Therefore, topological deformation implies the tension produced between structures; the horizontal structure given at the infrastructural level with its data transmission and the vertical structures that control such processes; at the level of appropriation and consideration of the large amount of data. Cf., Prado (2018).

[86] The initiative of the creators of the internet (Tim Berners-Lee) and the architects of the formation of the web was to contribute to an integrating and horizontal vision of the web (a propagation of the horizontality of the infrastructure towards the horizontality of relationships). This, as Lessig, one of its architects, points out in *The Future of Ideas* (2001) has not been possible as we can confirm today. The development of applications within the web 2.0 allowed to integrate the user in the creation and generation of content but also transformed the user's experience through new circuits of exchange and construction of social profiles (social networks) that would absorb their attention to transform it into manipulative behavior patterns.

(LeCun, 1990), or the *TD-Gammon network* that plays backgammon (Tesauro, 1992) (Alpaydin, 2021, p. 33). Along with this, probabilistic theory was being driven by Judea Pearl with the Bayesian approach which, as different from logic, could operate with uncertain information. Russell explains: "Although the basic ideas of probability were developed in the seventeenth century, only recently has it become possible to represent and reason with large probability models in a formal way" (2020, p. 273). Together with this, support vector machines achieved enormous success, Robert Schapire's "weak learning" model was of enormous importance for the field of machine learning. Jürgen Schmidhuber developed in 1991 the first deep neural network system which brought along in 1997 the long short-term memory (LSTM) of artificial neural networks. IBM introduced the first smartphone in 1992, Deep Blue defeated the chess champion Kasparov, and in the last year of that decade Google created the PageRank indexing algorithm. At the core of all this fundamental research, AI shifted from a knowledge-based approach to a data-driven approach. The advent of the internet, along with the previously described optimization of storage methods and infrastructures, the growth of data on the web, and the necessary automation of data by machine learning algorithms, prompt us to shift into *hyperhistory*.

§ 3. Patterns of hyperhistory

Recalling the last two sections, history begins with the extraction of the patterns of ancestry, the patterns found in nature and the universe[87]. The extraction of the pattern and its passage to its reproduction in recording and transmission infrastructure technologies implies a threshold towards a historical phase of patterns. In the historical phase, human intervention reproduces and improves, by means of technical mediation[88] or retentional technologies, the transmission of patterns. As we already described, the access of the pattern towards a historical phase is marked by the first pattern recognition of digital data by a programmable machine at the end of the 19th century (Sect., 2.1.).

[87] The ancestral pattern also regulated behavioral patterns to a different extent; for example, sacred exercises of early societies such as circle rituals imitating the movement of the stars (Seidenberg, 1981 in Restivo, 1992, p. 10).

[88] We shall be aware that it is not just about any technical mediation, there is also technological reproduction of patterns of nature through what is known as "biomimicry" or "biomimetics", nonetheless, these technologies do not recognize, record and transmit digital data.

But the threshold of patterns towards history was not only facilitated by the successive development of mechanical, electro-mechanical, and electronic technology for recognition, processing and storage of binary digits but also preceded by the development of modern mathematics. Modern mathematics, as we explained, became the «science of patterns» by liberating itself from the measurable magnitudes and proportions found in geometrical figures and abstracted itself to the relation between algebraic symbols which, in the early nineteenth century, would find an accelerated reproduction with propositional logic (earlier logic or algebra of classes)[89].

We have reached the stage of hyperhistory, characterized as the superior and current phase of patterns. In this stage, patterns already rely on the *hypomneses* of integrated circuits so that the world gradually, through the potentiality (*dunameis*) of the *algorithmic milieu*[90], takes the form of a *pattern based culture* derived by mathematical models. Hyperhistory is the celebration of a true virtual platonism[91] (Sect., Appendix., Chapter IX, §2., 2.2.). Patterns have already been extracted from nature, reproduced by technological and human mediation, and now, in hyperhistory, they are reaching their zenith with machine learning by means of many different methods involving pattern recognition techniques. We move from a recognition of geometric-visual patterns (ancestry), to symbolic-abstract patterns (history), to the statistical underpinnings of patterns (hyperhistory).

However, what occurs between history and hyperhistory? What is the feature that distinguishes this new historical-civilizational model? When technology ceases to mediate between the human being and the world (the period up to which Simondon's thesis encompasses) to mediate over itself ("technics-technics-technics") (see figure 1), it is when, as Sadin indicates, technology no longer administers or manages data alone, what is happening is something of much greater depth: there is an interpretative and decision-making power of the

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[89] Cf., Boole ([1854] 2017).

[90] Algorithmic milieu is an adaptation of what Leroi-Gourhan originally called *milieu technique*, particularly in his works and *L'homme et la matière* (2013 [c.1943]) and *Milieu et techniques* (2012 [c. 1945]).

[91] It has already been said, we are in the age of forms, in a culture of virtual platonism (Sect., Appendix, Chapter IX, §2., 2.2.). The essence of technology makes explicit that everything *tends to* and *gathers in* an uterine and *sphaeritas* form, a "techno-*sphere*" readapting Peter Haff's term (2014). It tends to the patterns that respond to underlying *mathematical* models. This historical context responds to a new return and turn of Platonism that re-emerges, after its Nietzschean inversion, and is actualized through the many computational processes of gathering particulars (data) around forms (models) while (in-forming) a pattern-based culture.

algorithms over that same data, a power of pattern formation that extends to all spheres of life. Sadin argues:

> The nature of the digital is modified. Up to this point it was structured primarily to ensure data management; now it is endowed with an interpretive and decisional capacity. This mutation, which today occurs on a massive scale, was made possible by the extreme sophistication of artificial intelligence (2018, p. 37, own translation).

The most accelerated mode of reproduction for the pattern is not technology but even more: culture, and particularly, digital culture concretized on the networking of online and social platforms. If culture is traversed by the constant, cumulative and massive collection and analysis of data coming from online platforms to predict all types of patterns of behaviors, it means that *it is culture itself where artificial intelligence plays its most vital game.*

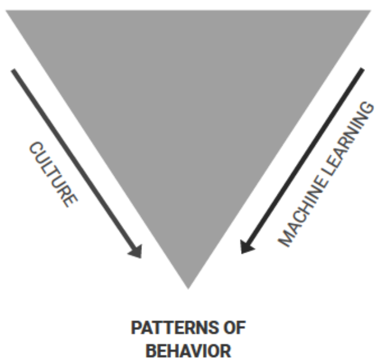

Figure 6. The vital relation between machine learning and culture

It is not by chance that the most distinguished phase of artificial intelligence, machine learning, is based on extracting meaningful relations from features and not on programming the complexity itself from the rules. The recognition of patterns in automated algorithms expresses, at a great level, the potentiality of perceiving or recognizing *features*[92] of similarities or resemblances using probabilistic data distribution techniques. This reflects the relationship of similarity between things that seem to be disconnected (Thompson, 1942, p. 9), that is, *apophenia* (Steyerl, 2019). This, as addressed through *Part II, Chapter VI, §1*. is technically called *adversarial examples*, when different objects share common attributes and which can be easily confused by an AI algorithm.

Such a problem has indeed a very philosophical root and the very debate is constantly brought into the field of AI: which attributes are essential or not to define any object and that the algorithm learns by induction through examples with those attributes. Attributes always exist in virtue of something else (i.e., there is something that is "white", that has the attribute "white") but furthermore, following Aristotle's distinction in his book *Metaphysics*, attributes can be essentially predicated or not. It is possible to distinguish between, "essential attributes": predicated as a constituent of the substance (snow is white), from those "non-essential attributes": predicated as having no vacancy and not essential with respect to the substance (not all human skin is white/pale). Still, in a different and reverse practice to that of the ancient Greeks, we no longer test from a concrete object the properties it contains, but on the contrary, we proceed by inducing from a set of properties or attributes (called inputs/ features variables) the pattern that these properties may share.

Interestingly, what utterly motivates technological evolution is the approach to patterns increasingly close to the mind itself: "AI itself has taught us that our minds are very much richer than psychologists had previously imagined" (Boden, 2016, pp. 2-3). The evolution of artificial intelligence is an evolution in the understanding of patterns of the world, and now, of culture itself. Such a claim even fits with the point of view of a great roboticist like Rodney Brooks: "The world is its own best model. It is always exactly up to date. It always has every detail there is to be known. The trick is to sense it appropriately and often enough." (Brooks, 1990, p. 5). The applied mathematical models, with their erratic approximation to the world, reveal the underpinning patterns of some state of it.

The *orgănum* of the digital is immersed in extensive vessels of reciprocal communication: network architecture (internet), data extraction (data), content (tools, libraries, and others), algorithms implementation (modeling). As an effect of the intercommunication of these drivers the emergence of new techniques enables a "«tracking economy» based on

[92] According to Bishop's definition, features are the result of combining the variables of various inputs in order to obtain a smaller number of variables, something that becomes necessary when the number of inputs is very large and efficient recognition of patterns is sought (2003, p. 2).

personal data, cookies, metadata, tags and other tracking technologies" (Stiegler, 2016, p. 19). Stiegler's wake-up call about the "digital turn of 1993" entailed an explicit historical-epistemological recognition about a new circuit of relations (of the trans-individual type) at the collective and individual level made possible by digital ordering or reordering. This appeals to the substratum of relations of the "machine-to-machine" type or "between-machines", "inter-objective", "hyper-historical" stage. It is all about the "new milieu that machines create for man" re-updating Canguilhem's vision (2008, p. 109).

The Italian philosopher, Luciano Floridi, recognizes the present historical-epistemological phase under the name of "hyperhistory", though, in a different manner than how we employ the concept in this context. Hyperhistory, in Floridi's terms, is preceded by pre-history (without recorded documents) and history (where there are already information storage and transmission systems (ICTs) but humans depend primarily on other types of sources and energies (2014, p. 6)). Hyperhistory takes place through what he calls the "information revolution" brought about by the transmission of digital information and is described as: "the stage of human development when third-order technological relations become the necessary condition for development, innovation, and welfare" (Floridi, 2014, p. 31). Such evolution is also classified according to first-order, second-order, and third-order technologies.

To understand the orders of technology it is necessary to understand their level or degree of mediation, what Floridi calls "*in-betweenness*". In the first order, technology mediates between the human and nature, citing some examples offered by him, a scissors between a hand and a rose, the axe between the user and the wood to be splitted. In the second order, technology mediates between the human and another technology, e.g., an engine provides power to other machines and mediates with the user as well. But in the third order of technologies, the technology is the user, the mediator and also the recipient of the information itself. For example, as can be found in the *smart home concept* today, a cloud-based artificial intelligence voice service (Alexa, Siri, Google Assistant, Cortana) can connect to the internet network to activate vacuum cleaners, switch the lights on and off, connect to the fridge, as well as many other autonomous devices. Another example can be found in systems that communicate with each other (e.g., API, application programming interface) to obtain data or verify credentials (for example, create an account from one application with the credentials of another, for example Google or Facebook). At this level, data processing implies a type of technics-technics-technics relationship (see, Figure 1). But, as Floridi himself notes, a technology is not exclusive to a particular order: an autonomous car, despite belonging rather to the third order technologies, still has the human as the main user. Regarding the relation between hyperhistory and third order technologies, Floridi explains:

> Essentially, third-order technologies (including the Internet of things) are about removing us, the cumbersome human in-betweeners, off the loop. [...] Technologies as users interacting with other technologies as prompters, through other in-between technologies: this is another way of describing hyperhistory as the stage of human development when third-order technological relations become the necessary condition for development, innovation, and welfare. It is also a way of providing further evidence that we have entered into such a hyperhistorical stage of our development (2014, p. 31).

For us, borrowing Floridi's concept, hyperhistory is the higher phase of storage, recognition, production, modeling and transmission of patterns between third order technologies. And it is a production of patterns mostly performed by advanced statistical automation. The construction of the third phase of the patterns, which we can roughly place from 1990 to the present, and which is in line with the year marked by Stiegler (*the digital turn of 1993*), consists of mature evaluations of the state of digitization and of the cognitive architectures explored so far in the field of AI.

Precisely, the decade of the 1990s inaugurates the deepening towards the metamorphosis of an automation even more autarchic with respect to the human agent, which continues the journey of two previous phases: *the first historical phase* of the seminal emergence of the digital universe (1850-1950) driven by the discussions and crises in logic-mathematics that led to the technological formalization of computable numbers particularly driven by Turing's machine[93] (1936). As Stuart Russell clearly writes: "Turing's new objects - machines and programs- are perhaps the most powerful mathematical objects ever invented" (2010, p. 33). And *a second historical phase* that corresponds to the so-called "information age" (1950-1990) whose digital revolution driven (particularly at the hardware level) by the evolution of infrastructure, transistors, resistors, capacitors in integrated circuits, among many other factors, while allowing the optimization of signal transmission and therefore, of digital information. These conditions (the digital and the information age) made it possible to enhance

[93] An extended description on the Turing Machine is to be found in: Sect., Appendix, Chapter IX, §2.: *Metaphysics of calculus: infinity and automation.*

the research vectors of the third phase: the AI age or the AI epoche (1990-onwards) towards the modeling, combination, and application of automated cognitive structures (symbolic, neural, and hybrids[94]) feasible to be enhanced by means of networked digital data provided by online platforms including all its digital resources[95].

A significant progress in the field began to be made towards the end of deterministic (non-random and perfect information) systems[96] through the rise of probabilistic inference in expert system technology (one of the first successful implementations of AI dating back to the 1970s). However, expert systems mostly relied on an encryption based on heuristic rules of the *if-then* type, based on data obtained by expert knowledge (hence its name) and whose operation associated a probability margin to each rule (e.g. through fuzzy logic techniques). Following this direction, the advance of Bayesian networks (1985) pioneered by Judea Pearl emphasized the subjective nature of information, which continued with this deterministic disruption and began to open the horizon towards *data* rather than *rules*, the data from which it was possible to estimate unobservable variables. This estimation framed the uncertainty of an event (information) not as a deterministic problem but as a stochastic one, that is, not based on rules but based on probabilistic methods. According to Russell & Norvig: "Judea Pearl's (1988) probabilistic reasoning in intelligent systems led to a new acceptance of probability and decision theory in AI" (2010, p. 26). And as explained by Russell alone:

[94] Hybrid architectures, which integrate neural processes with symbolic ones, began to be explored in the mid-1990s. See the works of Sun, R. (1993); Sun, R. & Bookman, L. (1994).Hybrid systems, for example, can combine connectionist and symbolic architectures, either by interfacing a symbolic control layer with subsymbolic perceptual and motor layers (Konolidge, 2002; Feldman, 2006 in Bach, 2009, p. 23).

[95] Without repeating the historical journey between Winters and Springs of artificial intelligence already found in most historical literature of AI, we shortly addressed it. As already known, towards the end of the 1990s, after the passage of the so-called "AI winter", there had been an enormous growth and financial incentive on the connectionist area (neural cognitive architecture) within the field of AI, today strongly associated with the concept of machine learning. Christopher Bishop, remarks about neural computing the fact that by that time it emerged as a "practical technology" and was successfully applied in a variety of fields (2003, p. ix).

[96] As Fogel indicates, chess is a clear example of a zero-sum, non-random and perfect information system. Regarding the first aspect, the gain of one participant indicates the loss of another, it is not random either, that is to say that the positions and distributions of the pieces are prefixed in the 64 squares, and in turn, it is a system of perfect information because the players have complete knowledge of the sources of their rival. See, Fogel, (1995); Jackson, P.C. (1985).

> [T]he israeli-American computer scientist Judea Pearl, who went on to win the 2011 Turing Award, had been working on methods for uncertain reasoning based in probability theory. AI researchers gradually accepted Pearl's ideas; they adopted the tools of probability theory and utility theory and thereby connected AI to other fields such as statistics, control theory, economics, and operations research. This change marked the beginning of what some observers call *modern* AI (2020, p. 42).

Statistical structures (arising from probabilistic methods and statistical pattern recognition) were progressively acquiring ground and being implemented in the cognitive domain around the 1990s although many of its algorithms were designed some decades before. These statistical structures were distributed in the network of interconnected artificial neurons (i.e., nodes with assigned values/weights, where each node represents a data structure). As the renowned director of Microsoft's artificial intelligence laboratory, Christopher Bishop acknowledges, *statistical pattern recognition* has a long history (Duda and Hart (1973), Hand (1981), Devijver and Kittler (1982), Fukunaga (1990), Ripley (1994), Cheng and Titterington (1994) and neural networks are an extension of it (Bishop, 2003, pp. ix). By the late 1980s and early 1990s, much of the computational literature took a decisive turn toward computational cognitive extensions that would aim to capture the ambiguity behind human thinking in a rather probabilistic manner.

As previously remarked, the *MIT Encyclopedia of Cognitive Science* noted that: "In fact, the 1990s may come to be seen as the decade of probability" (Jordan & Russell, 1999, p. 4). This entails a phase in which research trends and conceptual motivations were largely driven by probabilistic approaches especially in the historically rooted areas and interdisciplinary traditions such as *cognitive and computational neuroscience.* Its factual composition can be seen reflected in the extensive use of machine learning techniques nesting others such as: computer vision, robotics, reinforcement learning, natural language processing, neuro-symbolic reasoning, and many other AI methods. At present, probability as an approach for modeling algorithms in artificial intelligence is one of the many techniques in the field, however, it is one of the most explored and used models in today's computations. Having underlined these events, we can attain the idea of patterns in hyperhistory through large datasets (e.g., big data) analyzed through probability theory and statistical methods:

> The most general, and more natural, framework in which to formulate solutions to pattern recognition problems is a statistical one, which recognizes the probabilistic nature both of the information we seek to process, and of the form in which we should express the results (Bishop, 2003, p. 1).

Behind the statistical representation of the world[97], the idea of shaping the behavior of the world and the mind according to invariable laws becomes an exception applied to limited circumstances. Behind the statistical-mathematical applications in big datasets, the great epistemological problem of patterns, according to Floridi, are the "small data" (2014, p. 16), that is, the presence or absence of data adding value in the midst of the vast and growing data set. In a similar way, in the book, *Patterns of Discovery*, Norwood Russell Hanson pointed out when thinking about the phenomenon of patterns in microphysics: "In a growing research discipline, inquiry is directed not to rearranging old facts and explanations into more elegant formal patterns, but rather to the discovery of new patterns of explanation". (1958, p. 2). Finding "small patterns" or "new patterns" of explanation implies that the data variables are constantly actualizing and that there are no very clearly recognizable causes but divergence by chance and by relations between various variables at play: "we always want the patterns to be both nonobvious and useful" (Kelleher & Tierney, 2018, p. 4). As rightly pointed out by Boden, in connectionist models also known as distributed networks (parallel distributed processing, PDP) "each unit can be part of many different overall patterns, so contributes to many different meanings" (Boden, 2016, p. 82).

Hyperhistory thus consists of a dynamic tension that shifts technical mediation (big data and statistical, analytical methods) to become an eminently cultural problem: the reproduction and expansion of large and small patterns through the relation of third-order technologies, that is, of relations predominantly *between-machines.* Thus, the historical-epistemological condition of hyperhistory not only increases the scale of pattern reproduction as never before due to the improvement of infrastructures and technical designs, but also requires the leading role of culture as regulator of the patterns that attempt to be preserved and those striving to emerge (Sect., Part III).

[97] In this sense, formal truths become statistical approximations and, as Ortega y Gasset (1958, p. 11) recognized when referring to the use of statistical laws, the *real being* becomes a *probable being.*

3.1. From reality to symbols, from symbols to patterns

Hannah Arendt fairly recognized (1998) that a mathematically trained imagination is able to challenge any worldview even leading to the denial of all sense experience. Statistical inference (what any machine learning technique performs) stems not from immutable abstract models, it is rather derived from the sensory experience of skilled practitioners (generally known as data scientist) formerly associated in the context of modern technological infrastructure. The very practice of data science involves dealing, many times, with algorithmic models through trial and error. Still, no numerical vector, function or object defined by the very structure of equations is *by itself* an object of experience, but rather, it is a symbolic abstraction gathering attributes and mathematical process of relations (functions) between them. Every symbolic enterprise[98] is subject to the destiny of abstracting and narrowing reality itself.

> The basic machine learning work of "fitting a model" (or many models) to data is often literally implemented, [...], by constraining data with a coordinate, discretized space [...].
> Critical thought from phenomenology to social theory has a long-standing nervousness about the power of geometry and its gradual movement away from shapes and things towards mathematical operations [...].
> The crux of the problem rests on the "treatment" or operations that "reduce terrestrial sensibilities and movements" (Arendt, 1998, p. 265) to symbols. (Mackenzie, 2017, pp. 52, 53).

What Arendt (quoted by Mackenzie) was referring, in her work *The Human Condition* (1958), was to modern algebra, a mathematics which is not limited to space and its geometry proceeding from sensory perception. And what is beyond the sensory field itself? It is about the

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98 In the same sense as Mackenzie, by symbol, we do not mean symbolic computation as that from the origins of AI, we mean it in terms of the fundamental algebraic manipulation of mathematical symbols that enables the relations and transformation between variables in the first place. Mackenzie rightly addresses, "machine learners often distance themselves from the classical computer science understanding of programs as manipulation of symbols, even as they rely on such symbolic operations to function" (2017, p. 23). The author offered a clear archaeology of data practices performed by machine learning in his book *Machine Learners : Archaeology of a Data Practice* (2017) -what he refers under the name of "machine learners" is commonly known simply as "learners". He recognizes the crucial importance of the event fundamentally as a shift in the programming practice and relates it to a foucaultian articulation of new knowledge practices.

infinite expansion of mathematics beyond the apparent world, an expression of the patterns presented to the structure of the human mind itself (p. 266). Arendt further warned, beyond modern algebra, about the field of statistics whose problem is not that of large numbers, i.e., *mass society*, its problem lies in finding meaningful relations between those large numbers and the fact that "[i]n reality, [...] events will more and more lose their significance, that is, their capacity to illuminate historical time" (Arendt, 1998, p. 43). This claim has its influential roots in the 20th century philosophical trauma responsible for opposing "the human/ the essential/ the free spirit or conscious subject" to the "symbol" (when referring to modern mathematics) and to the "pattern" (when referring to statistics). This offense has been majorly attributed to mathematics and its applied sciences as Heidegger himself sought to ascertain[99]. What is the shocking offense about this divide? the reduction and limitation of human activities to *patterns of behavior* through the so-called "behavioral sciences". When referring in general to statistics as the mathematical treatment of reality, Arendt argued:

> [...] the social phenomena which make such treatment possible are great numbers, accounting for conformism, behaviorism, and automatism in human affairs.
> [...] the rise of the "behavioral sciences" indicates clearly the final stage of this development, when mass society has devoured all strata of the nation and "social behavior" has become the standard for all regions of life (1998, pp. 43, 45)

The root of this problem does not lie in symbolic conventions or statistical estimations of mathematics, the root of the problem is the rejection of mathematics within the philosophical production of the last century itself. This un-Platonic move is already over-indebted at a very high price. Let us begin with some preliminary observations. The symbol (*symbole*) as a problematic concept fully embraced the philosophical thought of the entire twentieth century[100].

[99] See later, in this very section, this discussion.

[100] Symbolic schemes of thought responded to a meta-phenomenal and relational character which were initiated at the end of the 19th century and throughout the 20th century by the field of mathematical logic. The fundamentally logical-philosophical and mathematical intersection sought, to a certain extent, to epistemologically recompose the truth by correspondence between empirical reality and the mathematical world. If in the 19th century physics had broken with the image of representation as a clear, extended reality, mathematics at the beginning of the 20th century would finish breaking it entirely through the meta-mathematical proof of Gödel. I

There might be, at least, two main distinctions of the concept. On the one side, the symbol, as an *algebraic expression*, hides the uncertain[101] and operates as an element opposed to the *structures of thought* (which *may* not be reducible to calculation). In this context, philosophers, logicians, and mathematicians who were taking over the key encounter of the correlationist thesis between structures of reality and structures of thought, pursued symbolic studies by means of formal and symbolic logic, that is to say, the isomorphism or correspondentism between axiomatic mathematical methods and any dogmatic true/false statement about the world (see, footnote 101). In other words, symbols became understood in accordance with the form of the mind. On the other side, and with a completely different sense, underlying and beyond logical factors, the symbol, as a cultural expression, hides the form of the spirit and operates as an integrating element of each area of culture (this is already present in the works of Hegel, Schelling, Herder, Vico, and Cassirer). For example, as called by Skidelsky (2008) Ernst Cassirer, "the last philosopher of culture", considered the central node of culture as unified under the phenomenon of the symbol, which implied the clear passage from the *animal rationale* (based on reason) to the *animal symbolicum* (based on symbolic forms) (Verene, 2000, pp. vi-ix). In the symbolic experience or symbolic reconstruction, symbols (e.g., myth, science, and art) are representative, significant of a whole experience. That is, the contents of

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extended on this in my paper, "Ambivalence in machine intelligence: the epistemological roots of the Turing Machine" (2020), where I wrote:

> The intrinsic relation between symbols and logical rules underwent a systemic déphasage. It collapsed with Gödel in 1931, the Austro-Hungarian mathematician demonstrated that pure formal deduction could not encompass all mathematics, which he revealed through a sort of self-referential proof known as "Gödel's Incompleteness Theorem". The greatest epistemological crash proceeds from this aporetic state of axiom systems which either imply contradictions or can't even be proven within the system, this is what is known as "Gödel's Incompleteness Theorem": roughly, "the impossibility to determinate the truth of any given formula" (Petzold, 2008: 52) (Prado, 2020, pp. 58, 59).

[101] Somewhere else I wrote:

> By operating symbolically, "mathematical reality" frees itself from correlationism with phenomenal reality and transcends it by means of the formalism of its language. By means of this, the symbols come to have the character of "indeterminate" (*incertorum*), an adjective used by Leibniz to describe algebra (1875). Precisely abstraction, abs-tractus, "without-stretch", as its etymology indicates, leads to the loss of space or concrete distances between two or more particular points (Prado, 2021).

experience are unified through symbols, just as in Kant they were unified through consciousness. The symbol thus belongs to a higher level of intuitive (non-discursive) capturing of reality, to a formative process of self-unfolding of the spirit. The symbolic system offered, in this way, to the spirit its most universal form freed from the passivity of external impressions.

Now when Arendt in the above quote of this section pointed out the reduction of the world by the symbol, the proper meaning is rather associated with the first use of the concept (the logical one) whose traces are exposed at a deeper level in Heidegger.

> The emergence of the question of being, too, its emergency especially, stemmed from the antiontological radicalness of symbolic thinking. In its complete revision of the question of knowledge in terms of the question of being, Heidegger's fundamental ontology was the most trenchant reaction imaginable to and most fundamental subversion of the entry into the symbolic beyond the exact sciences had undergone (Hörl, 2018, pp. 65, 66).

Heidegger's reading on the scientific procedure and the technical phenomena of his time was a landmark call to break away from both mathematical-ontological and logic-epistemic views and, by doing so, sink the titanic force of the nonsense that he found in the advancement of technology through the "oblivion of being" (*Seinsvergessenheit*)[102].

The convergence between metaphysics and modern technology, in Heidegger's case, was regarded as one of the greatest dangers at all levels and which can, in fact, be classified as

[102] Here is precisely where the sands of the epistemological thought begin to oxidize and leave room for the formation of silicon: *the symbol became a space of relational openness that has not led to the forgetting of being as announced by Heidegger, but on the contrary, has entirely absorbed it.* In this context, being did not pass into oblivion for the attempts of a rigid formalization of thought but has been effectively absorbed by the symbol whose nature is able to be operated under the frame of a relational ontology: "the unity of the being that remembers is the unity of the joining of symbols" (ILFI, 320). The pure exteriority of being is the symbol itself.

Being restores its cryptic essence in *nature* who, as the obscure Heraclitus revealed, loves to hide, in the *technology* who loves to externalize itself, and in the *human*, who loves that double unfolding of both, three instances that correspond to states where being unfolds and in which play its part in the same encryption at stake, of mutual dynamic and constant evolution. In this sense, the ontological problems around being had been absorbed due to the potentiality or virtuality of the symbol itself, which, in the same direction as the experimental and exact sciences, was losing the reference points with the substances of the world to become an approximate, statistical phenomenon, increasingly tending to processes of collective and relational ontologies.

not only a *factual* danger but primarily as an *ontological* type of danger[103]. The latter relied on the "totalizing tendency"[104] (*Gestell*) brought from the techno-scientific nullification to the question of *being-qua-being,* the objectification and saturation of being and nature, which, as a result, would undermine creative engagement and meditative thinking while planting the seeds of nihilism in culture[105]. The factual danger belonged to the exterminating power of technology made explicit by the historical world-wide war contexts from the middle of the 20th century[106]. This attitude towards technology in general is crossed by Hedeigger's "three veils" of abandonment (*„drei Verhüllungen" der Seinsverlassenheit*): the calculation, the speed and the emergence of the masses (Heidegger in Seubert, 2021, p. 104). Calculation, as opposed to thinking[107], dramatically involves "technological framing" (*Gestell*), again, the reduction of the world, of nature and ourselves as mere available resources (*Bestand*) for boundless production and consumption (Wendland, et. al., 2018).

Similar to Arendt's view, where the world's space is reduced by mathematical symbols, regarding the spatialized aspect[108] (*verräumlicht*) of the "technical entities", in Heidegger, technology supposes not only a reduction of distances, where "all distances in time and space are shrinking" (Heidegger, 2000, p. 167), but even more, a reduction of the world of *Being*

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[103] A detailed description of this danger can be found in his Bremen and Freiburg Lectures. For a complete understanding of Heidegger's philosophy of technology also see his canonical texts: Discourse on Thinking (1966) and The Question Concerning Technology (1977).

[104] "[T]he totalizing tendency implicit in the essence of technology (*Gestell*)" (Wendland, Merwin, Hadjioannou, (2018, p. 3).

[105] Also see, Kroker, A. (2019).

[106] Such a reading was, in any case, characteristic of the philosophical ethos of that time and whose impact would enable the development of technophobic theories around the very advance of the technique as such. An event that has been expansive and that belongs to some of the greatest thinkers of the 20th century, to mention some of them, besides Heidegger: Günther Anders, Hans Jonas, Jacques Ellul, Leo Strauss. These thinkers positioned themselves in the context of a completely bloody interwar arena, a context accompanied by a strong orientation in the progress of natural sciences and the final conformation of nation states.

[107] Heidegger in "*Gelassenheit*" underlines: "There are thus two types of thinking (*Denken*), each of which is, in its turn and in its own way, justified and necessary: calculating thinking (*das rechnende Denken*) and meditative reflection (*das besinnliche Nachdenken*)" (Heidegger, 1999, p. 13, own translation). One can also notice that this is precisely the opposite view to thinking as a mechanical process *in extenso* found in authors such as Thomas Hobbes, considered by John Haugeland the "grandfather" of AI: "By ratiocination, I mean computation" Hobbes (1656), chapter 1, p. 3. in Haugeland, J. (1985).

[108] Mostly present in his work, *Being and Time*. Cf., Heidegger, M. (1949; 1962).

itself. When everything is presented without a clear system of references for distances or time, without experience of ties or fixed durations, when everything becomes a "standing reserve" (*Bestand*), it is the moment, according to Heidegger, when technology has achieved the greatest conquest over Being. It means, it is the time when all our views about the world (*Befindlichkeit*) turn into an operational-technological procedure, or in wider terms, it is the time when the instrument exhausts reality. The dejection of the human (*Verfallen*) into-the-world-of-things (*Faktizität*) turns into - in a poetic and Abrahamic sense- an Adamic fall of *Dasein's.*

Badiou in his reading of Heidegger, for whom, conversely, mathematics opens up to the path of the original questions of *being-qua-being,* fairly recognizes:

> For Heidegger, science, from which mathematics is not distinguished, constitutes the hard kernel of metaphysics in as much as it annuls the latter in the very loss of that forgetting in which metaphysics, since Plato, as founded the guarantee of its objects: the forgetting of being (Badiou 2005 [1988], p. 9).

In this sense, as Badiou recognizes, numerical domination, at both ontological and political levels, is one of the most important philosophical tasks of our present time and shall not fall into an "anti-mathematical romanticism" (Mackay in Badiou, 2008, p. viii) as already found in Heidegger's view on the essence of technology and, at a great extent, on Simondon's view regarding the mathematical aspect of technology (Sect. Part I.).

If the philosophy of the twentieth century was characterized by opposing thinking to the symbolic order (encompassing the statistical order as well), the young century may assume an enormous effort to allow a more clear convergence between applied mathematics together with critical thinking or spirit itself. Only from such a bridge, it may become possible to philosophically and culturally rediscover or revive the elements of evolution, of *individuation*[109] nested within contemporary technology itself.

The last two universal philosophers[110], Martin Heidegger (1889-1976) and Gilbert Simondon (1924-1989) were the major contributors to underline the essence of technology across their own ontological frames and, in both cases, find similar structures between the realm

[109] The distinction between *individuation* and *individualization* is addressed in the next chapter.

[110] This recognition of Heidegger as the last universal philosopher was pointed out by Badiou as a fundamental assumption for today's philosophy. Cf., Badiou, A. (2013).

of metaphysics[111] and the realm of technology. However, while Heidegger was responsible for extending the vilification of the former in relation to the latter (in which science and modern industrialized society were included)[112], Simondon aimed to unify[113] their respective *sacredness* and *technicity* into *Culture* (PST 329–334). The following chapter aims to offer an introduction to Simondon's concepts, especially regarding individuation, information, and technical objects while, by means of a new reading of his work, opening the first axiom of this thesis, the ontological axiom, based on how patterns in-form (give-form) to reality.

111 According to Heidegger, the concept that he takes up of metaphysics responds to the Hellenic philosophical tradition that deals with the study of "being as such and as a whole" (2010 [c. 1929], p. 8, own translation). But it is the definition of the German philosopher Alexander Gottlieb Baumgarten (trained under the same orientation as Kant: Leibniz-Wolff) who provides the definition of metaphysics pertinent to the study of being in Kant: "Metaphysica est scientia prima cognitionis humanae principia continens" (Baumgarten in Heidegger, 2010, p. 5). Heidegger's interpretation is that the foundation of metaphysics is found in Kant's *Critique of Pure Reason*, whose fundamental ontology deals with the dogmatic principles of all possible knowledge. Cf., Heidegger, (2010): *Kant und das Problem der Metaphysik*.

112 Cf., Wendland, A. J., Merwin, C., Hadjioannou, C., & Francis, T. (2018).

113 There are at least two processes of unification in Simondon, on the one hand, the methodological-interdisciplinary, which he calls *Allagmatique* (*allagmatic*), in which he tries to bring together and normatively relate the schemes of philosophy and psychology with scientific and technological schemes, such as: the theories of structure (astronomy, physics, chemistry, biology), theories of operation (cybernetics, information theory, technology in general), among others. On the other hand, there is the aforementioned metaphysical-philosophical aspect where Simondon seeks to bring together the metaphysical aspects of the primitive magical unity (technicity and sacredness), which leads him to seek the integrity of the technical dimension around culture, a responsibility that, according to his analysis (MEOT, third part), belongs to philosophy. For a detailed analysis on the concept of allagmatics, Cf., Bardin (2015) pp. 6-18.

Part I

Patterns of in-formation:

the ontological axiom

If the doors of perception were cleansed

everything would appear to man as it is,

infinite.

William Blake, *The Marriage of Heaven and Hell*

CHAPTER III

Technology and crystallization

§1. Simondon's conceptual introduction

Nature, technology, and the living contain within themselves a common and *universal process or inner logic* to which Simondon referred under the concept of *individuation*[1] [2] (for

[1] It is important, to underline a notation difference when referring to non-living/physical individuals, for such cases, Simondon mainly refers to the concept of individua*liza*tion which applies to any informational system with the potentiality of creating a *milieu* that will conditionate its own functioning. This is precisely what makes the concept of *information* and *relation* almost indistinguishable from each other. However, in order to assign the differentiating and evolutionary function of the term "individuation" we introduce it here as an information formula in living and non-living systems. This problem is expanded along the whole chapter. Cf., Iliadis, A. & Mellamphy, N. B. & Barthélémy, J. H. & de Vries, M. J. & Simondon, N. (2015). Also see, Hui, Y., (2015).

[2] Individuation understood as a *common process* was identified by Stiegler in the following way: "Simondonian thought overcomes the oppositions between types of individuation by referring to traits common to all individuation processes" (2015, p. 55). Furthermore, Hörl refers to individuation as a universal process (*universeller Vorgang*) within, on the one hand, the integral program of Simondon's philosophy of technics and nature, and on the other, the cybernetic historical context. Both methods offer a reconstellation of technology and nature (pp. 239-240) in: Cf., Hörl (2017). Also see, Hörl (2013).

the living beings[3]) and *individualization*[4] [5] (for the technological beings): "the individualization of technical beings is the condition of technical progress" (MEOT, 59). As Barthélémy argues Simondon's essential works[6]: *L'individuation à la lumière des notions de forme et d'information* [Individuation in the Light of the Notions of Form and Information] and *Du mode d'existence des objets techniques* [On the Mode of Existence of Technical Objects] compose the heart of his "Genetic Encyclopedism" whose aim is to "think individuation of physical, vital, psycho-social and technical beings" (2015, pp. 19-20).

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[3] According to Barthélémy (2015), Simondon's thinking on living beings has received little attention, mostly for two reasons: the first one is, the living being is the most difficult object to think and the second one is, that it contains the hidden unity of Simondon's work (p. 16). The living being, precisely, "as distinguished from the physical, maintains its own becoming in terms of an individuation understood as a genesis" (p. 20). On this topic: Barthélémy, J. H. (2015); and (2005) particularly *Chapter IV*; also see: Fagot-Largeault, A. (1994), and Petit V. (2010).

[4] In his work, *Acting Out*, Stiegler distinguishes *individuation* from *individualization* by considering the latter as a corollary of the former, namely, as its own effect:

> Individuation is not individualization. Individualization is the result of individuation, which is itself a process, through which diversity in general, that diversity which I am and equally the diversity which we are, tends to unify and, through that, tends towards the in-divisibility of the in-dividual, that is its pure adequation to itself (Stiegler, 2009, p. 4).

[5] It is noteworthy that Simondon has indeed referred to "a certain level of individuation" of technical objects in a direct way, as in the case of the motor, which is also consistent and coherent with itself. Cf., *Réflexions sur la techno-esthétique* from 1982 (RTE, 389).

[6] Simondon's doctoral theses consist of two main works, Simondon's primary doctoral thesis: *L'individuation à la lumière des notions de forme et d'information* (ILFI) and the secondary doctoral thesis: *Du mode d'existence des objets techniques* (MEOT), the latter published after his defense in 1958 through the Aubier-Montaigne publishing house. Six years later, in 1964, the publisher PUF published his primary thesis under the title: *L'individu et sa genèse psycho-biologique,* however, this version was not only modified but did not contain the last two chapters of the second part. This version will later be amplified with several paragraphs of the doctoral thesis, not previously included, and two final supplementary texts: *Analyse des critères de l'individualité* and *Le problème de Allagmatique*, by the publisher Jérôme Millo in 1995. In 1989, Aubier publishes only the last two chapters of the second part under the *title L'Individuation psychique et collective: à la lumière des notions de forme, information, potentiel et métastabilité.* It is only in 2005 that Jérôme Millon publishes, as we know it today, *L'Individuation à la lumière des notions de forme et d'information* which was published in Spanish in 2009 (Ed. Cactus and La Cebra Ed.) and in the English language in 2020 by the University of Minnesota Press.

To primarily grasp the concept of *individuation* in Simondon one shall differentiate it from that of the early medieval ages (especially since Boethius)[7] [8] and to the much-later born psychoanalytic tradition (driven by Jung)[9]. The formula to understand individuation in the French philosopher lies in the very concept of *information* by which *so much biological as well as physical organizing principles* can be understood. One of the most disruptives analyses treated by Simondon which has lasted up to the present day has been to consider the operation of technological models or technical objects as a basis for understanding the process of *becoming*. From Simondon's study the genesis and evolution of technical objects was undertaken on the basis of how information is preserved, increased or degraded, namely how information trans*forms* and varies one form into another.

Capturing the world through information is a revolutionary event that initially belongs to the intellectual *cybernetic* tradition[10] initiated by the mathematician Norbert Wiener at the end of the 1940s and later renamed as *artificial intelligence* (AI) in the summer of 1956 in Dartmouth by John McCarthy. Today we are beyond any doubt in the artificial intelligence epoch. John Brockman (2020) has been the responsible editor for bringing together the

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[7] As a research on *individuation* in Boethius explored by Faitanin (2015) points out, individuation, whose problematic root is found in Aristotle's *Metaphysics*, is not a topic strictly treated in Boethius, however, what there is in Boethius is a theological-logical contribution about it:

> [T]he cause of plurality and of numerical diversity. However, through the search for these two causes, in a certain way, we are allowed to ask about the cause of individuation, because as St. Thomas has rightly said in his *Expositio Super Librum Boethii De Trinitate,* what is principle of individuation is principle of diversity, according to number" (Faitanin, 2015, p. 4, own translation).

[8] On this topic also see, Gracia, J. J. E. (1988).

[9] We offer a detailed analysis on the relation between Jung and Simondon in: Chapter III, §2. and Chapter IV, §1. Also see, Jung, C. G., Hull, R. F., & de Laszlo, V. S. (2021).

[10] In addition to the historical context that gave birth to cybernetics as initiated by Wiener (1948), the term can also be defined by a more broader sense, according to Galloway:

> [...] in a more general sense, cybernetics refers to any kind of regulatory system in which human and nonhuman agents are connected in networks of control and communication. Because of this, cybernetics is often credited with inaugurating a particular historical relationship between subject and world. Specifically, cybernetics refashions the world as a system and refashions the subject as an agent (2014, pp. 112, 113).

contemporary AI experts and followers of Wiener's intellectual tradition. He argues that before AI there was cybernetics (based on automating the self-control of information through feedback processes) and that, given the refusal of the pioneer John McCarthy[11] to use the term «cybernetics», he decided to change it to «artificial intelligence», while placing himself as the founder of the field (Brockman, 2020, pp. xx). However, it is important to clarify that, today, cybernetics and artificial intelligence are recognized as different fields containing precise technical differences that exceed McCarthy's personal appreciation for Wiener. These differences are mainly found in the fact that cybernetic models (electronic and mathematical based) respond to interactions such as feedback, control, and communication which mainly involve the regulation of information, and therefore, are feasible to be transmitted to informational mechanisms where the *relation* plays a fundamental role (e.g., information theory, biology, political economy, sociology, psychology). While, on the other hand, artificial intelligence responds, from its inception[12], to formal logical models and, extensively in its current state, to mathematical applied models while combining various methods from several disciplines (e.g., cognitive and computational neuroscience) in order to computationally implement architectures inspired by rule-based automation, mental processes, genetic evolution, cellular automata, and dynamical systems.

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[11] Jaron Lanier puts Wiener's contentious relationship with his colleagues into context and distinguishes the terms as follows:

> One reason the term "artificial intelligence" came into being (at a conference at Dartmouth in the late 1950s) is that more than a few of Wiener's colleages couldn't stand him. They felt compelled to come up with an alternative name, because cybernetics was starting to catch on and was associated with Wiener. The alternative they came up with did not mean the same thing. "Artificial intelligence" purported to describe qualities of future computers without reference to people. [...] "Cybernetics", by contrast, proposed only that computers and people would have to be understood in the context of each other (Lanier, 2018, p. 58).

[12] Cf., Appendix, Chapter IX, §1. *Automated technology and the problem of representation.*

Simondon recognized the intellectual spark of cybernetics[13] [14] ignited by Norbert Wiener and called his work the new *Discours de la Méthode*, that is, the 1948's foundational work: *Cybernetics: Or Control and Communication in the Animal and the Machine*. Just as Descartes' *Discourse on the Method* became the hallmark of the birth of modern thinking (the use of reason as a method for initiating modern experimental science), so Wiener's Cybernetics became, at a great extent, the hallmark of the second half of the twentieth century too (the use of information as a method for initiating contemporary automated self-organization).

Although Wiener's mathematical studies were based on probability theory for signal processing and noise distinction on analog[15] rather than digital computers, the intellectual flag of cybernetics gave rise to a territory whose extension seems limitless and whose horizon we can still appreciate today[16]. In particular, two mathematical branches became a key to understand the concept of information: on the one side, to the use of «probability» to model uncertainty (to a great extent, this is what fostered the seeds of modern AI) and, on the other side, the use of «statistics» to estimate the probability of an event. Estimation accurately address the problem of *error* which gave a final shift in how to adapt new information during the so-called "learning process":

[13] The first cybernetics, of which Wiener was part, along with McCulloch, Rosenblueth, Bigelow, Pitts and Von Neumann together with Grey Walter and Ross Ashby occupied an important role on Simondon's understanding of the field together with some of the main representatives of properly French cybernetics, such as: Louis de Broglie, Louis Couffignal and Albert Ducrocq who Simondon regarded to have a completely different treatment of information as that of the US cybernetics (based on circular causation) (Heredia, 2017, p. 212). The dynamical and transformational schemes of information in cybernetics (a transdisciplinary study on control and communication of agents) is what drove Simondon to a mature reflection not founded on particular objects or privileged systems (where individual and milieu are already given) but on the relationships that give rise to them in the first place.

[14] On Simondon and cybernetics, cf., Bardin, A. & Ferrari, M. (2022); Heredia, J. M. (2019); Rantala, J. (2018); Triclot, M. (2008).

[15] To understand the technical applications of Wiener's method around non deterministic signals: see Chapter 11 from "FIR Wiener Filters and Random Signals" in Moir, T. J. (2022).

[16] Seth Lloyd, a contemporary and remarkable participant of this tradition, call the attention in Brockman's book about the relation between Wiener's applications and today's connectionist approaches: "In particular, Wiener's applications of cybernetic concepts to the brain and to computerized perception are the direct precursors of today's neural-network-based deep-learning circuits, and of artificial intelligence itself" (2020, p. 6).

> [T]hrough the nineteenth century many statisticians began to use probability distributions as part of their analytic tool kit. These new developments in mathematics enabled statisticians to move beyond descriptive statistics [demographics or economic data] and to start doing statistical learning (Kelleher & Tierney, 2018, p. 11).

Their mathematical design proceed, as described by Kelleher & Tierney (2018), by the nineteenth-century mathematics based on Laplace's problem of *zero probability in Naïve Bayes* and Gauss *method of least squares* as foundation of statistical learning methods together with the twentieth century mathematics of *modern hypothesis testing* from Karl Pearson and statistical methods such as, *multivariate analysis* and *maximum likelihood estimate*, from Ronald Fisher. Upon the mathematical foundation of probability, statistics has been built. While the former deals with uncertainty, through the possibility of an event happening in the future, statistics distinguishes itself by dealing with error, the frequency of past events to infer future ones.

Statistical mathematical frameworks, in a certain way (not made explicit and even denounced by Simondon[17]) still influenced Simondon's proposal of considering cybernetics as a method for cultural and psycho-social studies. One of the first specialists who began to study the French cybernetic phenomena of the 40's and 50's in relation to Simondon is Xavier Guchet (2010) who through his concept of "technological humanism" analyzed the axiomatization proposed by Simondon of the human sciences through cybernetics in conjunction with the psychosocial sphere. Guchet indicated that the first one[18] to find the explicit relationship between statistical regularities (and, therefore, the application of cybernetics) and human activities was the monk and philosopher Dominique Dubarle. The monk was an erudit on mathematics and epistemology pioneering the idea that the human processes "seem to present a certain statistical regularity, such as economic phenomena or changes in public opinion" (Dubarle, 1948 in Guchet, 2010, p. 66, own translation). Guchet later conjectures, it can only be the *object of government* that which is previously *mathematically defined.*

Under the combination of machine intelligence and statistical inference, Wiener foresaw (as well as Simon Butler (1863), Alan Turing (1948; 1950), and Irving John Good (1965) after him and who worked with Turing himself) the "*machine à gouverner*" and the

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[17] This is expanded in Sect., Chapter III, §1.,1.3.: *The limitations of Simondon's notion of information* and deepened in Chapter IV, §1.: The concept of *pattern* in Simondon.

[18] See, footnote 55 from Part II.

possibility of the human "losing control" upon its creations[19]. This brought about the new relational and organizing power driven by *information machines* based on machine's "self-regulation" or "learning" as different from the previous thermodynamic machines based on mechanical-work.

The investigations of the automatism of French cybernetics (Louis De Broglie, Albert Ducrocq, to what also Pierre de Latil, Georges-Théodule Guilbaud belong) and Anglo-Saxon cybernetics (Norbert Wiener, Ross Ashby, Walter Grey, Alan Turing, Herbert Simon, Donald Michie, Stafford Beer, John McCarthy, Marvin Minsky, Allen Newell, and Gordon Pask), according to Simondon, were, in both cases, gravely mistaken for considering the "automaton model" as the archetype of technical perfection. Juan Manuel Heredia wrote: "Simondon passionately fustigates the idol of the automatic machine, in whose shadow he also sees the genesis of the discourses relative to the mechanization of man, the threat of the machine and the alienating character of «technics»" (2017, p. 213, own translation).

Simondon described the new logic of self-regulation of the information, grounded not on the logic of causality or finality with determinism but on "causal circularity" opened to the milieu which should thus lead towards the very coupling of the human being (form creator) with the machine (form receiver): "There is an inter-individual coupling between man and machine when the same self-regulating functions are better and more subtly accomplished by the man-machine couple than by man or machine alone" (MEOT, 135). This coupling can be factually appreciated, for example, in how Wiener applied mechanisms such as modulators in negative reactions, control and feedback loops to neuromuscular feedback of living systems (Lloyd, 2020, p. 5). In this context, Wiener's idea explicitly arose: the machine has the potentiality to become a regulator (governor) not only of its own information embedded under physical systems and laws but of the complete human behavior, as well as of society as a whole. Hence, in the early or first cybernetics context, the ever-growing expectation of matching and interfacing human (neural signals) and machines (mechanical-electrical signals) took place.

Indeed, Simondon's central denunciation of cybernetics is based on the unfounded relations of identity between the living and the automaton. As Barthélémy (2015, p. 20) analyzes, it is rather a matter of the living serving as a model while guiding the progress of the technical object (individualization). A progress that is only possible through the relation of the technical object with its *associated milieu*[20]. Hui explains: "For Simondon, the associated

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[19] On the relationship between human behavior and the cybernetic vision from Norbert Wiener, cf., Galison, P. (1994).

[20] Cf., Sect., §2., 2.1.: *Techno-genesis: the elements for evolutionary technology*

milieu isn't only a self-regulating mechanism that protects the object, but also the modulator that facilitates individuation" (2014). The associated milieu of the technical object or machine implies: autoregulation, modulation, and universal reticulation, which, according to Bardin, it contains the true "evolutionary potential" (2015, p. 208).

When Simondon attempted to constitute a new phase of the philosophy of technology, he remarked, as we already cited in the *Introduction*: "Philosophical thought will not be able to grasp the sense of coupling between man and machine unless it manages to elucidate the true relation that exists between form and information" (MEOT, 150). That very relation or coupling is only possible and given by pre-existing individuation. According to the simondonian scheme, although machines integrate the data of preceding stages and even if they regulate their own teleological mechanisms, this machine will always simply adapt but never actually change the orientation of its purpose, its structure, or its form. He differentiated this adaptation as either training (*formation*) or learning (*apprentissage*). The former has a patterned (fixed) behavior according to a given milieu, while the latter manifests the ever-becoming differentiating itself in relation to the diverse milieus.

In a more mature work from Simondon, "Psychosociology of Technicity" (1960-1961), we already find one of the most widespread debates in the public domain on artificial intelligence without being explicitly acknowledged by himself. In this work, he pointed out that the open technical object is neotenic *(néoténique)*, namely, it is always in a state of construction as an organism in the process of growth. Keeping in mind the operating schemes of living systems and non-living systems, he distinguished between *self-adaptive behavior* and *conversion*. The machine is capable of self-adaptation but not of conversion, it can not convert its ends, its structures or forms. The following was written as an appendix to his doctoral thesis (1958) just before Simondon himself removed it for his oral examination: "man is capable of conversion in the sense that he can change *goals [fins]* throughout the course of his existence; individuality is beyond teleological mechanism because it can modify the orientation of this finality" (CN, 420). This is an important idea that had been circling around Simondon's thought for a long period of his life: although the machine (agent or technical being) can adjust and adapt its behaviors, it cannot change the ends (goals) for which it was predetermined, while differently, the human being, is capable of conversion, of breaking with predetermined patterns: "the slave can revolt, while the machine cannot" (CN, 420). Nonetheless, Simondon's project was designed precisely to free machines from the servile and merely instrumental role while welcoming them into culture, even basing their existence on an onto-genetic view: the *technical being.*

1.1. Introducing process metaphysics into the machine

The need of looking for underlying, *chthonic,* metaphysical grounds was already provocative and of apparent strangeness by the second half of the twenty-century when Simondon proposed his genetic metaphysical scheme[21]. With this, Simondon opened up a new path in philosophy and culture where being became an everlasting process (*becoming*) and was no longer regarded as the already individuated result (what traditional metaphysics instead proposed). The loaded concept of individuation implied regarding the process of being as an informational processes able to reshape from particular to collective systems from the living to the physical beings, and particularly of interest here, technical objects[22].

Simondon's first moment which covers his early formation around the notion of individuation and his philosophical (*allagmatic*) conception of cybernetics (from 1953 to 1958) addresses two key works: his first philosophical thesis later entitled as "*L´individuation à la lumière des notions de forme et d´information*" (ILFI, 1958) supervised by Jean Hyppolite and the second doctoral thesis, *Du mode d'existence des objets techniques* (MEOT, 1958) supervised by Georges Canguilhem. During the first period, the author brings together his

[21] The main interpreter and translator of Simondon in the Spanish-speaking world, Pablo Rodriguez, points out (2017) that unlike philosophers from his generation, who were characterized by the destruction of magnum systems (e.g., Deleuze, Lyotard, Foucault, Althusser, Barthes, Lacan, Derrida), Simondon, in turn, combined one of the last philosophical systems influenced by Ionian physiologists (in an old-fashion way) together with an unseen new resource: *cybernetics*, giving thus place to a novel philosophical system. Nonetheless, it deserves to be highlighted that Deleuze's writing represents a notorious effort and commitment to reconcile (intersect) philosophical/ontological spaces with scientific/ mathematical frames and that his analyses have proved fertile for thinking more broadly about the intertwining of cognitive processes individuated in human or computational circuits. For example, Deleuze's readings of Spinoza's immanent metaphysics allowed the disarticulation of two important attributes: thought and extension (attributes of God), and thus the first breaks into the ontological and representational boundaries between the natural and the artificial.

[22] Again, it is important to distinguish that what Simondon means by individuation becomes significant with living beings and distinguishes itself from individua*liza*tion (particularly, physical beings, and technical objects). Hui wrote: "These concepts need to be distinguished and then questioned to bring into light how Simondon understood the relation between the biological and the mechanical" (2014). Simondon's schemes constitute the exceptional turn of our time through his onto-methodological proposal of individua(liza)tion for the case of *technical beings* or *technical objects*. Upon the genesis and evolution of these schemes, the true structure and true essence of technicity can be understood.

investigations on the concept of individuation, which according to a letter written to Bachelard, dates from the beginning of his doctoral research in 1952[23].

In his first doctoral thesis, he broke with the two philosophical traditions of Western thought: the substantialist thesis of being as a fixed and necessary entity dependent on a previous system (monistic thesis) associated to platonism and the thesis of being as a combination of the relation between form and matter (hylemorphic thesis) associated to aristotelianism. According to Simondon, being is considered in terms of an operation and relationship not entirely conditioned by any given system not even by itself: "the complete being [...] is more than itself" (*autre que lui-même*)[24]. He then explained in his summary of ILFI: "The knowledge of individuation has been hampered by the pregnancies of the hylemorphic scheme, of technological origin but which contains social implications that have contributed to maintaining a central dark zone in it"[25].

The formula of individuation (relational and differential process) implies so much the *living* as well as the *technological individuals*[26]. Intelligence of any individual, in these terms,

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[23] All letters and biographical references of Simondon belong to the biography written in French by his daughter, Nathalie Simondon in her website: http://gilbert.simondon.fr/content/biographie .Citations from French to English are all under own translation. The following is an extract taken from it: "In his letter to Bachelard of 1952, Simondon expresses: «since this spring I have been working on the notion of individuality (*individualité*). This subject seems to me to be deeply reflective, therefore philosophical".

[24] Cf. Nathalie Simondon, http://gilbert.simondon.fr/content/biographie , own translation.

[25] Idem.

[26] The individual, from its Scholastic interpretation (*in-dividualis*) meaning, what is not-divisible, represents the medieval conception of the Holy Trinity (Williams, 1961; Raunig, 2016; Bruno & Rodriguez, 2021). It is that which despite its differences and particularities remains as an indivisible whole. Hence, individual necessarily implies a system of unity, a general complex model of the world. Stiegler made clear the relationship of individuation with the *in-divisible* in the following terms:

> The process of individuation, in fact, always tends towards unification, towards becoming-one, that is, in-divisible (as the word in-dividual literally signified), and yet it never ceases its becoming, and is therefore never actually completed [achevé] and always remains to come. (2011, pp., 37- 38).

In other line of analysis, Raymond Williams considered also that its sacred origin derives or is later extended into principles of logic particularly of that of *classes*:

is not a correspondence between form and matter. The hylemorphic tradition of the substance (*ousiai*) as a correlation between *matter* and *form* no longer subsists; they are subordinated to the very process of individuation. In other words, the active operation of form upon the passive state of matter can not explain the genesis nor the evolution of information systems. Between form and matter, there is what Simondon calls "the obscure zone" (Scott, 2014; Chabot, 2003). In terms of Simondon, the formula or *operation* of individuation is the *ontological*[27] [28] *and methodological starting point* where any evolutionary process takes place.

> Simondon seems at times to be effectively heading towards the construction of a new metaphysics which, faced with the problems opened up by a set of scientific-technological effects, does not deprive itself of going to Greek thought for intuitions and schemes that allow it to construct its own concepts (Heredia, 2017, p. 295, own translation).

> 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 (Hui, 2016, p. 142).

Simondon's concept of individuation was inspired mainly by the physics of the 19th century[29] (based on relations and forms) as different from that of the 18th century (based on

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> The logical problem extended to other fields of experience, and «individual» became a term used to indicate a member of some group, kind, or species. The complexity of the term is at once apparent in this history, for it is the unit that is being defined, yet defined in terms of its membership of a class (1961, p. 73).

27 With this we agree with Pascal Chabot on the foundational purpose of Simondon's philosophy: "The driving force of Simondon's critique is ontological" (Chabot, 2003, p. 47).

28 On individuation and its ontological value, Simondon explained:

> This is why the study of individuation [...] has a very profound ontological and epistemological value: it invites us to ask how ontogenesis is accomplished based on a system bearing energetic potentials and structural germs; there is individuation not of a substance but of a system" (ILFI, 93).

29 It is important to note that the relational capacity of cybernetic machines considered by Simondon are in tune with a realist and relational and non-substantialist ontological scheme. Cf., Bontems, V. (2016b).

particular substances). This was accompanied by his utmost metaphysical inspiration: a deep review of ionic physiologists[30] and the new ground of cybernetics by the mid 20th century. As Heredia describes, Simondon traced three fundamental points from Greek philosophy for the construction of his genetic metaphysics: Thales de Mileto (dynamism of physis), the esoteric doctrine of Plato (ágrapha dógmata), and the infinite first principle of Anaximander (ἀπειρου - ápeiron) (Heredia, 2017, pp. 312- 313).

Genetic metaphysics is critical of traditional metaphysics. In the latter reality is derived from first principles (in its monistic as well as hylemorphic versions) and where being is presented as already given, formed and individuated. Ludovic Duhem analyzes the ancient Greek influences and metaphysical aspects in Simondon and addresses the fact that in his proposal there is no derealisation of being (*déréalisation de l'être*) but rather the construction of a true ontological thesis (Duhem, 2008, p. 4).

> What Simondon essentially criticizes is the history of metaphysics for not having considered the operation of individuation in its ontological value. From the Presocratics to Kant, philosophy has in fact assigned itself as its original task the search for first principles, thinking of "being as it is individued" «être en tant qu'il est individué» instead of "being as it is" «être en tant qu'il est» (Duhem, 2008, p. 2, own translation).

In fact, what Simondon found was the tool to transform being into becoming, that tool is what he referred to under the concept of *individuation*. The operation of individuation proposed by Gilbert Simondon describes how the process of information and energy within

[30] As found in Nathalie's Simondon website. He wrote in January 1954, to Hyppolite:

> I chose the notion of individuality (*individualité)* and, for a year, I have been trying to make a reflexive theory of the criteria of individuality. (...) in fact, it is necessary to grasp being before it has analyzed itself as an individual and a milieu: the individual-milieu as a whole is not sufficient in itself; we can neither explain the individual by the environment nor the environment by the individual, and we cannot reduce them to one another. The individual and the environment are an analytical phase genetically and logically posterior to a syncretic phase constituted by the existence of a prime mixed. We find here an intuition of the Ionian physiologists, of Thales in particular (Simondon in Nathalie Simondon, http://gilbert.simondon.fr/content/biographie., own translation).

systems constantly alter and differentiate the individual while exchanging with its milieu, its *associated milieu*. Schick resumes the function of the milieu in a favorable way:

> The individual constructs and builds structures in its milieus. Simultaneously, it is structured by the milieu. While transforming its milieu the living being is transforming itself. This constant process of individuation is characterized by an ongoing recursive causality with the natural milieu and continued via the technical object (2017, p. 55).

Here information is not related to its logical-mathematical formalization nor to the conversion of potential energy into dissipation (second law of thermodynamics) but rather, into genesis, into individuation (metastability). In this sense, for Simondon the energetic states of a system reflect a scheme of processes and dynamics that make it possible to weave the profound relationship between *technology and being.* Why? because both are information processes able to *in-form* reality. Simondon found this common destiny, this progressive becoming between the two in Culture, the very source of all information processes (Sect., Part III).

In this sense, the French author created the metaphysical ground for technical objects or machines, a metaphysics based on ever-updated states of information that allows further evolution. In a sense, the constant uncertain processing and transformation of information through its milieu is a transformation of the being itself. This continuous dynamic of individuation is regarded as an ontogenetic process. The ontogenesis is the very ground for the operations (becoming) of being where physical, biological and psychosocial realities from their micro to macro aspects are shaped (in-formed)[31]. For this very reason, the common task of the information processes shared between them accomplishes the purpose of individuation, that is to say, it openly transforms while uncovers reality[32]. However, it uncovers reality not because it contains totalities of being or absolute realities in itself but because "it is phases of being"

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[31] One can identify in Simondon's scheme, the strong influence that Bergson had over Simondon's theory. The philosophical supposition (Bergosonian supposition) that there is an active force (*élan vital*) by crafting forms, and that this elemental force primers information, refers to the ability to capture, to gather the information and convert it, to give form, to transfer, to in-form, to give a specific meaning to something. Cf., Bergson, (1944).

[32] This relational and ontological assumption becomes more explicit in his former thesis of 1958 which is an enterprise to distinguish individuation from the form-matter aristotelian project: "To utilize the hylemorphic schema is to suppose that the principle of individuation is in the form or even in the matter, but not in the relation of the two" (ILFI, 35).

(Duhem, 2008, p. 4). This allows the understanding of why the processes of information came to imitate the three phases of the movement of being: pre-individual, individual, and transindividual.

> His key concept of 'individuation' asserts the primacy of ontogenesis, a primacy of processes of becoming over the states of being through which they pass. Further, Simondon approached the question of epistemology as a function of ontogenesis. There is an individuation of thought, he said, by the same token by which there is an individuation of matter, on the physical plane and from there on to the plane of life, and following – or prolonging – the same constitutive principles. He recognized technological innovation as a key theatre of thought materializing in matter becoming, in ways imbricated with life transformations. Technology was a fundamental concern for him throughout (Boever, et. al., 2012, pp. 20-21)

This begs the question: in which terms was Simondon referring to information? The notion becomes clear when, so much Simondon as well as then followed by Deleuze, regard the individual as a *signal-sign system* (Deleuze, (1994 [c. 1968]), p. 222) affected by the use of the energy which is contained in the system itself. The individual is a system of signals-signs. A system that, as Jean-Yves Chateau analyzed, is defined by energy and therefore "contains internal tensions, potential energies, metastability, internal resonance (2015, p. 26), and, in those conditions, it is in terms of *communication*, that it is determined «the true principle of individuation»" (Chateau, 2015, p. 17, own translation). Briefly expressed, Simondon analyzed the evolution of both living organisms and information machines upon the basis of the degree of *organization of signal reception*. The technical object itself is not that which merely functions, it is that which is capable of, above all, receiving signals.

The information referred within Simondon's framework is the one that crosses through any system of physical magnitude in the context of its interaction with electromagnetic fields. This event responds to the relationship between, at least, two fundamental conditions: signals of energy (atemporal) and signals of potential (per unit of time). It is precisely the finitude or infinitude of the energy of a signal and the potential of a signal which define the signal-system itself. Nonetheless, so much Simondon as Deleuze[33] employed the concept "information" mainly under the energetic conditions of living systems, which, unlike physical systems, does not exhaust its potentials. From this derives the concepts of «metastability» in Simondon and «intensive difference» in Deleuze which are the key terms to redefine the post-dialectical individual, an individual or system whose transformations are in continuous openness and indeterminacy. From this very event, an unprecedented energetic system such as *thinking* itself is born[34].

Individuation contains the metaphysical attribute, like Leibniz's Monad or Spinoza's substance[35], of deciphering systems of the whole world, a readable source that allows us to decode the very nature of reality through a formula of being. Nevertheless, in Simondon's genetic project reality is made as it individuates, it is not already given. Hence, individuation is another index of organization of reality, a genetic index whose differentiated nature, according to Barthélémy (2012), becomes only meaningful with living beings. In an effective and final sense, the principle of individuation is the driving force of being towards the singularity and the increasing difference between individuals. As Deleuze synthesized when retaking Simondon's conceptual framework: "Individuation does not presuppose any differentiation; it gives rise to it" (1994, p. 247), here the pristine and original sense of the concept is preserved. Therefore, individuation is a dynamic process of intensive (neither qualitative nor quantitative) differentiation.

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[33] For the relation between individuation in Simondon and transcendental empiricism in Deleuze, Cf., Voss, D. (2020). In this regard, also see the article entitled "Penser après Simondon et par-delà Deleuze" in: Barthélémy, J.H. (2010).

[34] This notion gives place to the conclusion that the never achievable threshold of individuation is what enables thought itself (see later this argument as quoted in: ILFI, 77). Deleuze, together with Guattari expressed about this fact the following: "Individuation emerges like the act of solving such a problem, or - what amounts to the same thing - like the actualisation of a potential and the establishing of communication between disparates." (Deleuze & Guattari 1994, p. 246). In this sense, the concept entails an open exclusion of the extensive determinations (both qualitative and quantitative classification) of the individual. The individual, in both cases, neither begins nor ends at a particular site or point of time-space because it is dependent on an intensive field of individuation. Accordingly, information interacts in a field of intensities that contains *ex-post* the extensive limits (physical or numerical magnitudes). Following Simondon, *metastability* is the fundamental condition for the individuation process (Barthélémy, 2012, p. 217).

[35] Juan Manuel Heredia points out that Bergson's critique of both metaphysical systems, coming from Leibniz and Spinoza, in their relationship especially with modern science, generates a "static, timeless and eternal vision of reality" (Heredia, 2017, pp. 294, 295).

By assigning individuation to the information regime of machines, Simondon introduced a metaphysical scheme of processes in the machine. Furthermore, he called them "technical *beings*". The general theory of automation owes a debt here: *there is no theory of "being" in artificial intelligence* partly due to the fact that, following Simondon, being precedes all possible logic. It does exist, in fact, an "ontology of objects", of concrete substances but not an "ontology of ontogenesis, of relations" (Scott, 2014, p. 21). How could a general frame of "cognitive automation" be oriented to the problem of genesis?. In fact, a problem that is not computable but intuitive. And why is it critical to drive this analysis? Simondon offered a fair cause: "In order for a thought to exist, it requires not just a logical condition but also a relational postulate that allows for its genesis to be accomplished" (ILFI, 77)[36]. As we already indicated, it is precisely this double helix of information that we must explore in order to approach the relationships bridged between *form* and *information*.

> Simondon sought a philosophy that could account for evolution. A philosophy that was supple and mobile, like the process of becoming itself; a philosophy that followed the genesis of things. He had an aversion to principles: fixed, foundational laws. Evolution does not follow a predetermined course; it is a process (Chabot, 2003, p. 73).

Individuation, which is neither matter nor form, is the *allagmatic operation* or *technologie réflexive* (as called in MEOT) that relates both through the updating of relations of potential energy (ILFI, 32). Individuation has micro and macro physical positions. Simondon also reverses Plato in this sense, his doctrine is not based on accidental substances brought together by the idea (*eîdos*), but rather, in the relation expressed between material interactions. This is indeed the thesis that Simondon elaborated along *Individuation*, that the form becomes the *structural germ* and the matter (unformed) the *metastable potential*.

[36] David Scott in his book *Gilbert Simondon's "Psychic and Collective Individuation"* argues on the key role of thought as the launch for the process of individuation: „Thought, which now appears to institute an inexplicable relation between object and subject, is the prolonging of the initial individuation" (2014, p. 20). On the basis of the *consensus philosophorum* between thought and becoming, Massumi writes: "Thought does not reflect the real. It is real. It has a reality on a par with the world's becoming" (2002, p. xxxii).

Simondon greatly adapted the concept of individuation to all dimensions of reality[37]: *nature* (where biological processes participate), *psychology* (at the stages of human affective-emotional and cognitive operations), and *technology* (the technological *element, individual, and set*). The latter dimension, which occupies our greatest interest, has the potentiality of ever-evolving relations: the relation of machines within themselves (*autocorrelation*), with the human being (*mediation*) and with culture (instrument of modification and regulation of the human with the world). For him: "individuation is not a process restricted to a single domain of reality" (ILFI, 261). Therefore, it relates informational processes of a system within themselves and their environment. In other words, the evolution of an information system under a process of individuation is not exhausted but continues indefinitely.

Nonetheless, the superiority of the individuation process[38] is not uniform throughout all beings. It finds its deepest dimension in the living being, the most complex information system of all: "*The living being conserves within itself an ongoing activity of individuation*, it is not merely a result of individuation, like the crystal or molecule, but a theater of individuation[39]" (ILFI, 7). Precisely, Simondon captured how in-*form*ation systems (particularly, human-machines) carry potentials that allow its forms to evolve from the discontinuity and differentiation between structures and functions.

Following a different metaphysical route than that of Aristotle, Plato and the scholastics, Simondon unearthed the fundamental problem of reality and information: the form-taking problem. In this way, artificial intelligence (as a system) inherits the metaphysical problems of *how to in-form reality*. The current state of the art in advanced information processes (AI) continues to corroborate this paradigmatic event. The study of the genesis and evolution of

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[37] As exemplified by Chabot: "Examples include the biological processes of hormonal regulation within the body and electronic devices ranging from the tube lamp to cutting-edge applications of nanotechnology" (Chabot, 2003, p. 51).

[38] It is a process that allows differentiation (a change of form), a process of becoming and of trans-formation when embedded within an associated milieu.

[39] An analysis and further progress on the use of the term *theater* by Simondon when referring to individuation can be found in: Cf., Schick, (2017, p. 54):

> For Simondon "theater" is more than just metaphor. The "theater of individuation" describes the ontological situation of an individual in the making. Each individual – be it a human subject or a technical object – is embedded in a milieu and consists of a multiplicity of elements that interplay with each other. This interplay between the different actors and props on stage and the surroundings is the essence of the practices that any processual ontology seeks to address.

artificial intelligence is a study of how to algorithmically recognize and compute patterns, of how to in-form the vastness of digital data.

Information ceased to be an expression of logical, axiomatizable or even probabilistic formalism to become an intensive, relational, differentiable problem on the "uncertainty of forms". Information, even more in the AI context, is an onto-genetic phenomena:

> [I]nformation is not form, nor is it a collection [*ensemble*] of forms; it is the variability of forms, the influx of variation with respect to a form. It is the unpredictability of form, not pure unpredictability of all variation (MEOT, 150).

The externalized logical-mathematical distribution of energy, matter and code do not allow us to understand the very relational sense of the information[40]. It is rather through the path of individuation that Simondon stated a key call: "it is only by following this path that the rapprochement between the living being and the technical object makes any true sense, beyond any mythology" (MEOT, 51).

1.2. Technological individuation

With the passage to an "artificial intelligence epoche", Simondon's understanding of individuation (as a universal method for growth and evolution), and information (as the germ of technical evolution) have both been already and radically reelaborated. Simondonian thought is contemporary of Deleuze (Simondon's main interpreter), Foucault, Derrida and Lyotard and has been taken up by Italian philosophers (Agamben, Esposito, Virno) as well as themed from a cybernetic point of view by: Stiegler (1994), Barthélémy (2005), Hörl (2008), Hansen (2012), Guchet (2010), Bardin (2015), Blanco and Rodríguez (2015), Hui (2016), Mills (2016), and

[40] Bardin explains very clearly the predominance of energetic distribution upon mathematical relations in Simondon:

> For Simondon this is enough to prove that there is no constant mathematical relation (direct or inverse) between the quantity of energy input into a system and the quantity of information transmitted. On the contrary, it is the actual distribution of energy in a system, i.e. its «form» or «quality», which determines the quantity of information that can be transmitted. [...] What actually produces/transmits information by differentiating information from background noise, is in fact the relation between the code and an energetic variation (2015, p. 29).

many others to be mentioned. All these authors explore and update the problem of "information", "technical object" and the "milieu" in Simondon as the central concepts to think about contemporary technology. Furthermore, the works from Hörl (2013), Stiegler (2016), Hui (2016), Sauvagnargues (2016), Schick (2017; 2021), Bunz (2019), Rieder (2020), endeavor to update Simondon's reading on AI-related aspects.

In this vein, Erich Hörl, while exploring the ontogenesis of becoming, diagnoses a passage to a general ecology based on a new eco-technological condition, a cybernetic state of nature associated with increasingly environmental media able to embrace and couple, equally, natural and unnatural elements. Moreover, Bernard Stiegler questioned whether the current processes of psychic and collective reorganization (psychosocial individuation) still respond to a question of individuation. Individuation not only has been interrupted but it has been even inverted by cultural and cognitive technologies (becoming processes of *disindividuation*), while giving rise to new circuits of transindividuation (Sect., Part III, § 2., 2.2). Likewise, Mark Hansen notes a new technogenesis derived from human-machine coupling beyond the technical object and based on a model of perceptual and cognitive distribution and a new development of the ontology of media operations derived from Simondon's concept of individuation. Futhermore, concerning authors that aim to extend the concept of individuation on technical objects: Yuk Hui reenacts the Simondonian program of the technical object and its associated milieu through his proposal of rethinking a digital object and digital milieu by giving them structure through the general concept of relations. Johannes Schick considers the technical objects as external or virtual theaters of individuation actualized by human practices. Other derived digital implementations of the technical objects are those of: Bernhard Rieder (2010) who explicitly poses the software program in terms of a "technical object", of "a being that functions" while focusing on algorithmic information order (e.g., search engines) as a central practice; similarly, Coline Ferrarato (2019) attempts to introduce the implementation of technical object's functionalism in open source web browsers (such as Mozilla Firefox) only to name a few current examples. At the core of these theoretical-methodological conjunctions between individuation and technology remains the *púr technikon* (the cosmic fire) of the "becoming of technology" sparked by Simondon.

Behind the automation of information processes between the agent and its given milieu lies a process of *adaptation* which enables *co-evolving systems* and whose dimensions and complexities are expressed in the perceptual unity[41] of action. When referring to adaptation in a computational agent or system, this can be roughly understood as: the selection of performance measures that drives to a local optima whose values correlate with the best possible (expected) result (Russell & Norvig, 2010, p. 130). Or as Russell himself later updated: "More recently, a consensus has emerged around the idea of a rational agent that perceives, and acts in order to maximize, its expected utility" (2020, p. 23).

In the crude taylor-made AI systems exist two predefined substances known as "agents" and "environment" which store information structures (input-output chains) able to give rise to certain functional relations [42] [43]. This basic operation is described at the beginning of the most quoted book of the history of artificial intelligence written by Russell and Norvig first in 1995:

> How well an agent can behave depends on the nature of the environment; some environments are more difficult than others. [...] An agent is anything that can be viewed as perceiving its environment through sensors and acting upon that environment through actuators. [...]
> Mathematically speaking, we say that an agent's behavior is described by the agent function that maps any given percept sequence to an action. (2010 [c. 1995], pp. 34, 35).

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[41] In *Individuation…* from 1958, Simondon wrote: "perception retains everything that is particular and incorporates it into the whole" (ILFI, 230). Later, in his work, *Perception et modulation* from 1968, we find that the perception can achieve such integration of part-whole unity to reality because, originally, it is able to distinguish between figure and background which he took from the *Gestalt* theory: "the perception at this level of analysis can be defined as what dualizes the field into figure and ground" (PM, 243, own translation). Simondon even emphasized, in a previous work, that perception exceeds the role of symbolic intelligence: "[L]anguage is not necessarily an instrument of intelligent behavior. Possibilities for intelligent behavior exist everywhere an integration activity can be put into practice, and particularly in perception" (CI, 315, own translation).

[42] Simondon pointed out that between energy (not organized but continuous) and information (organized and organizing) there is *modulation*. Thus, he paradigmatically noted the modulating process (i.e., a synthesis between form and energy) in nutrition (with energy input), in perception (with information processing) and in the organization of energy output (acting on the environment) (PM, 196-197).

[43] Agents (artifacts with computational resources) and environments (parameters to be taken into account), whose perception is triggered by sensors that derive in the activation of actuators and are visualized through their action/response. Cf., Russell and Norvig, 2010, pp. 34-36.

What is presented in this very general and introductory description requires an important distinction pointed out already by Russell and Norvig: the "agent function" corresponds to the mathematical relationship, while the "agent program" is the concrete computational implementation running within a physical system. In this context, "intelligent agent" is what Simondon following Wiener recognized as "causal circularity" and called by Massumi[44] (2012) as "operational autonomy" or as specified by one of the main Simondon's references, Raymond Ruyer: *automaton* in the sense that it is capable of self-controlling its information. That is, the regulation of information exchange[45] aims to continue functioning without intervention, i.e., automatically.

We shall notice that the historical-epistemological process occupied by Simondon is conditioned by a clear difference between thermodynamic machines (e.g. the steam engine) and information machines (i.e. the beginning of cybernetics, the institution of self-regulated behavior or "learning"). Thus, in all his writings Simondon epistemologically isolated the notions of energy and information while trying to define a common mode of existence between both individuals, the machine and the human.

In his presentation of Simondon's combined works written after his doctoral thesis, between the sixties and the seventies, *Communication et information* (2010), Jean-Yves Chateau notes that, for Simondon, the technological model consists fundamentally of three *transductive*[46] sets (effector, receptor and motivational sets) which, in their progressive

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[44] Massumi was the first specialist to undertake the attempt to translate Simondon into the Anglo-Saxon world. See his interview with Arne De Boever, Alex Murray and Jon Roffe: 'Technical Mentality' Revisited: Brian Massumi on Gilbert Simondon. Also see, the Journals like (e.g., Parrhesia [2009], SubStance [2012], and Australasian Philosophical Review [2015]) which made available much of Simondon's literature in the English language (Bardin, Carrozzini, Rodriguez (2019). On the internationalization of simondonian Studies, see: Bontems, V. (2016a) and the specialized journals and dossiers shown in the final bibliographic section.

[45] Today that exchange is increasingly vast, implying: energy, signals, states of messages, network packets, and all its infrastructure. We can readily conjecture that information as the formula of becoming can be manifested not only on how information is *managed* at the electronic current level (treated with considerable interest by Simondon) but also in the process of what nowadays is experienced at the level of *data managing,* that is, how information is transformed in the code itself. This can be identified under very different software-based relations, to name only one example, such a becoming can be captured in the logic of program operations CRUD (create, read, update, and delete) which ultimately can contain all the conditional operators (if/ elif/ else, for/ in, while, function, class, method).

[46] Transduction is an amplifying operation that occurs where the energy of a given system is propagated while modifying its own internal state and by which, for example, as Chateau indicates, the crystal is enlarged and reality

actualization and differentiation, carry out the process of individuation (2016 [c. 2010], p. 16). In his 1960's text *Attitudes et motivations,* Simondon wrote: "we consider the genesis of the triad *receptor* attitudes - *motivations* - *effector* attitudes as equivalent to the very process of individuation; receptor attitudes are isomorphic to perceptual-sensory receptors, motivations to processing functions, and effector attitudes to organic effectors" (AM, 378, own translation, own italics)[47].

At the philosophical level, an *agent intelligence theory* (based on the actor-effector postulate) might appear as an oversimplification of the relations between (the provoked action) of the effector and (the impact of the effect) on the receiver. Precisely, the meeting between actor/form and effector/matter bears a traditional substantial metaphysical ground that Simondon had initially rejected in his former doctoral thesis (ILFI, 1958). In other words, the traditional or classical postulate of artificial intelligence (1950-1990) has rather a correlation to the traditional substantial metaphysics assumed, mainly, by the hylomorphic theory from Aristotles where the (active) form of the effector operates upon the (passive) matter of the receiver. Simondon's speculative metaphysical proposal argued, conversely, that it is the *relation* what defines both: the agents[48] and their environment and not contrariwise[49] [50].

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is amplified (*la réalité s'amplifie*) (Chateau, 2015, pp. 14-15). The concept is clarified in the section called: *§2. Crystal-based technology.*

[47] The axis on modulation and amplification processes of both the organism and the technological model can be found in: *Perception and modulation* (1968), the *Course on instinct* (1964), and *Attitudes and motivations* (1960).

[48] Simondon did not make use of the concept "agent" but of "individual". For the sake of tidiness and coherence with the arguments presented, we have decided to keep "agent" in the cases referring to artificial intelligence and to return to the notion of "individual" when we call specifically on Simondon's theoretical framework.

[49] Simondon, in this context, when referring to the concept of adaptation, refers to the evolutionary theories of both Darwin and Lamarck. When referring to the process of adaptation of behaviors, that is to say, modification of structures in machines, see especially: *Mode of existence of technical objects* (1958), *Complementary Note on the Consequences of the Notion of Individuation* (1958), *Psychosociologie de la technicité* (1960-1961), and *L'invention dans les techniques* (1971).

[50] Simondon further considers this stimulus-response scenario as posterior (sensory) being preceded by the conditions of growth of the organism (motricity):

> To say that motricity precedes sensoriality is to affirm that the stimulus-response schema is not absolutely first, and that it refers to a situation of actual relationship between the organism and the environment which has already been prepared by an activity of the organism in the course of its growth. (II, 29, own translation).

> The notion of adaptation is poorly formed to the extent that it supposes the existence of terms as preceding that of relation; [...]; what deserve to be critiqued are the very conditions of this relation coming after the terms. [...]
> The sensory universe is not given all at once: there are nothing but sensory worlds waiting for action so that they can become significative. Adaptation creates the milieu and the being relative to the milieu, the being's path; before action, there are no paths (ILFI, 234, 235).

Neither object, nor subject, *solum* individuation. Simondon's proposal can be resumed as follows: "instead of grasping individuation on the basis of the individuated being, the individuated being must be grasped on the basis of individuation and individuation on the basis of pre-individual being" (ILFI, 12).

As Barthélemy analyzes (2012), individuation always occurs with respect to an *associated milieu*. Following this *philosophe déroutant* as referred by Guchet (2010), the milieu is the inexhaustible provider (*inépuisable fournisseur*) whose signals affect a system in a metastable state[51] (i.e., a system that contains many potential transformations) (CC, 59-62). Now, if we refer to the relationship between the agent and the environment, it is not primarily because of the terms entering into relationship but because of *the relationship itself*. The relation of such *mode d'existence* meets a new evolutionary phase *if and only if* it enters a metastable phase: "To adapt a being (*être*) to a metastable society is to give it an intelligent learning that allows it to *invent* to solve the problems that will be presented to it on the whole surface of horizontal relations" (PRE, 237, own translation). True automation requires metastability. This begs the question of *why Simondon tried to connect metastability to the process of learning itself*.

[51] The concept of *metastability* is precisely pertinent in this particular context. In the article "L'invention dans les techniques" (1971), Simondon devoted a section called "Exemples d'inventions et de perfectionnements post-industriels, de type scientifique" in which he stated that after the unfolding of the sciences, processes of energetic efficiency for the transfer of information take priority. In this context he wrote:

> The principle is no longer the stable equilibrium or the indifferent equilibrium, but the metastable equilibrium; the major imperative is not the adaptation to the extreme terms nor the performance in the intermediate links of the transformations[...]. The main concern now is the fidelity of information transfer (p. 253, own translation).

Underlying metastability there are open conditions for the resolution of tensions or problems, Hörl explains in his reading of *Individuation*: "The present of the living being is the metastability of relation between interiority and exteriority, past and future" (2017, p. 252). Deriving conclusions, *the learning process* thus becomes the ever-actualized passage that *communicates the past with the future*. In a curse dictated by Simondon, *Initiation à la psychologie moderne,* (1965 - 1966) he defined *learning* in the following terms: "learning is a systematic modification (in a determined direction) of the behavior when the same situation is repeated" (IPM, 349, own translation). The relation of the individual or the agent with its associated milieu evolves through learning (as well as through previous and lower stages of adaptation and training). This also implies changes in the morphology of energy exchanges and information exchanges while matching with Russell's definition of intelligent systems: "Choosing an action by looking ahead and considering the outcomes of different possible action sequences is a fundamental capability for intelligent systems" (2010, p. 257)

At this point, it is our ambition to ask ourselves: from what point of view does the field of artificial intelligence begin to draw this very relation between humans and machines? Besides, the general "agent intelligence" introductory description, two abstract and foundational perspectives about AI may allow to grasp its contemporary image:

- "We start by modeling artificial intelligence on a conception of who we are" (Galison, 2018).
- "We re-create ourselves in their image" (Brockman, 1995).

Both views share some merit. The first anthropocentric view around the notion of AI, corresponds to the physicist and historian of science, Peter Galison, who pursues a traditional scientific procedure by breaking down the abstraction into concrete specific practices and techniques. And the latter corresponds to the already mentioned nodal editor of most recent AI literature, John Brockman, from whose reading, one can see the potentiality of technology itself to shape our ways to perceive the world, our own subjectivity. To the latter, we can add, as we attempt to claim along our thesis, AI as a force of cultural transformation. Supporting this claim, the world leading AI expert, Stuart Russell illustrates today's AI as follows:

> More than one hundred billion people have lived on Earth. They (we) have spent on the order of one trillion person-years learning and teaching, in order that our civilization may continue. [...] This is now changing: increasingly, it is possible

> to place our knowledge into machines that, by themselves, can run our civilization for us (2010, p. 255).

The above mentioned quotations contain two concrete images roughly capturing two-sides of the same coin about AI. They express what doctrine about subjectivity is assumed: whether it is a technology built and limited from a human perspective (but not exclusively) or it is the human perspective which is being largely shaped while AI is being continually developed. A third epistemological position expressed by the AI researcher, Margaret Boden, could be added to these two: “If and when it exists, machine-driven associative search will be improved and supplemented by machine understanding” (Boden, 2016, p. 38). In the latter perspective, there is no longer the construction of a common image, but rather the predominance of one over the other. Although the two formers scientific perspectives lend an air of a “mutual image” or “some image of thought to be constructed” between the two cognitive-based entities, human and machine, there is still a fact already assumed by Simondon: if there is an attempt to construct a common “cognitive image”, all the vital axiomatic is to be based not in the image of one or the other but on their *associated milieu*[52]:

> The compatibility of elements in a technical individual presupposes the associated milieu: the technical individual [...] is a stable system of the technicalities of elements organized as an ensemble. [...]
> The intrinsic determinations, based on the technicity of each element, are those which constitute the associated milieu. This associated milieu, in turn, is the concretization of the technicities contributed by all the elements, in their mutual reactions” (MEOT, 74).

In its initial considerations, the notion of *milieu* ascribes to the “artificial milieu” thesis of André Leroi-Gourhan[53] and Georges Canguilhem in which they propose “the artificialization

[52] What lies behind this is a new *adaptation process* on both *actants*. All adaptation is a process of permanent ontogenesis: “adaptation is an ongoing ontogenesis” (ILFI, 234) and the adaptation of psycho-social patterns merged in data and their computational reconfiguration is no exception. Precisely, Simondon pointed out that in the course of ontogenesis, “automatic centers” emerge, programmed, automated behaviors (CSI, 247).

[53] In *Psychosociologie de la technicité*, the author emphasized the importance of Leroi-Gourhan's influence on the genesis of technical objects in his works: *L'Homme et la matière* (1943) as well as *Milieu et techniques* (1945). In

of life as the starting point of hominization" (Stiegler, 2016, p. 9). In short: evolution and hominization is mostly a result of processes of technical externalization, of *technogenesis*. The living being *engenders technics* (what Anne Fagot-Largeault calls "technical neo-Lamarckism"[54]; Barthélémy, 2015, p. 18). It is enough to account for the manipulation of nature by other species (animals) to realize that this property does not arise unexpectedly or has been solely cropped up in the cognitive architecture of humans. In 1968, Simondon concluded: "Techniques are not only human; they are also a certain aspect of animal activity; technical activity is [...] an oriented activity of organized beings" (IDT, 225, own translation)[55].

Simondon agreed with Lamarck's doctrine, separating himself from Darwin[56] (Fagot-Largeault, 2014) on the theory of evolution of the living organisms: mutations and selections are not enough, nor does it depend on the random and arbitrary action provided by its *milieu* (e.g., by supplying water and nutrients), but the organism itself *chooses* to organize and regulate matter, energy, and information inputs. The evolving organism chooses its own relationship with the milieu (CI, 249-261). To evolve is to become an organizer of *information flows* supplied by the internal[57] and external milieus. The information flow allows what Simondon emphasized under the concept of *communication*. Communications between organisms,

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the 1968 *Interview on Mechanology,* Simondon once again stressed the influence of Leroi-Gourhan's *Milieu et techniques.* Cf., Leroi-Gourhan, A. (2012), and (2013).

54 See footnote 55.

55 For Xavier Guchet, the technical manipulation by animals, the use and manufacture of tools, is very clear at the baseline of Simondon's program, for whom, the human should not be separated from the animal world. This is also found, as the author indicates, in ethology studies such as Lestel (2001) in his work: *Les origines animales de la culture* (Guchet, 2010, p. 15).

56 Yuk Hui holds a markedly different position from that of Fagot which he makes clear in a commentary on an interview by Thierry Bardini to Anne Fagot-Largeault. For Hui, the analogy between technical and biological beings is functional to the figure/background distinction and should not be extended beyond it, which is why he proposes the revision of the distinction already made by Simondon: individuation versus individualization. In addition, Hui doubts that, as Fagot affirms, Simondon is "fundamentally a Lamarckian", and this is due to the construction of Simondon's concept of milieu as different not only from that of Lamarck, but also from that of Darwin, and from that of his own thesis advisor, Canguilhem. Cf., Hui, Y. (2014). Differently, Barthélémy, agrees with Anne Fagot-Largeault on her idea of Simondon's position as "technical neo-Lamarckism" while he points out that "Simondon made reference to Darwin and Lamarck, but in order to discuss their respective concepts of «adaptation»" (2015, p. 18).

57 The idea of "internal milieu" was taken up by Simondon from Claude Bernard, a 19th century scientist. A notion that later, Heredia (2017) points out, will become increasingly important in cybernetics studies, in particular through William Ross Ashby's *Homeostat*.

machines and milieus "give existence to a functional circle (*cercle fonctionnel*) for both the machine and the living being" (CC, 70).

Canguilhem, the director of Simondon's secondary doctoral thesis (*Du mode d'existence des objets techniques*) claimed that the essential role of technology must be "a universal biological phenomenon and no longer just an intellectual operation of man", and consequently, "one is led to inscribe the mechanical within the organic" (2008, p. 96). Canguilhem's call has a bearing on the universalist demand of the Encyclopedists of the eighteenth century, well-pursued by Simondon later, that is: *to return technology to nature.* We dare to express even more: the fact that technology imitates nature is the plan behind all mathematization of reality.

The thesis of the designs of species (*Gestaltung*) as a product of their adaptation with respect to the environment brings with it the requirement that each species dominates and organizes its experience according to its specific design. In the first instance, the (biological) structure allows the exchange of information functions with the environment, this functional circle is then turn into formalized experiences. According to Canguilhem's formidable contribution: "Such technique is heteropoetic, adjusted to the outside, and takes from the outside its means, or the means to its means" (2008, p. 9).

Technical mediations by species thus imply that a specific biological design adjusts to its environment through the manipulation of elements integrated to, borrowing a programming expression, its "precompiled routines", namely, to its inner program brought by design. So that the design (anatomical features) matches to the functions necessary for the resolution of problems presented by the environment: "Doubtless, the animal cannot resolve all the problems we present to it, but this is because these problems are ours and not its own. Could man make a nest better than a bird, a web better than a spider?" (Canguilhem, 2008, p. xviii). The best-hosted philosopher by the AI community, Daniel Dennett, expressed the same in other terms: "Eyes are of no use to a tree unless it also has some way of using the information" (2017, p. 120).

In accordance with the argument raised by Canguilhem, the question about the *design of intelligence* becomes different from that of the *conscious representation*. From the very beginning, human-representation and machine-intelligence face different types of problems in relation to their environment. The former seeks to compress intelligence into abstract models whose abstraction is general enough to make sense of its environment, the latter can be automatically aware of the patterns of those models without the need of attributing them any kind of sense (*Sinn*). As one may expect, conscious representation, as different from intelligence, is an uncorrelated (Sloman, 1992), uncomputable (Penrose, 1989, 1995), mixed regime of causality and efficiency, as well as a veritable transductive relation (ILFI, 272, 311) that links the individual not only to itself but also to the world (ILFI, 272). Thinking is to intelligence what representation is to consciousness: *obscure*. Human conscious representation faces its thresholds in favor of the expansion of its own image.

One of the first attempts to separate "intelligent behavior" from "conscious representation" was made by the great mathematician Alan Turing in 1950 based on the question of whether a machine can think[58]. Stuart Russell besides offering the most complete definition of an intelligent agent as already mentioned, notices Turing's distinction on these two concepts: "Turing explicitly tried to separate the two, focusing on the objective question of intelligent behavior while admitting that consciousness could remain a mystery, as indeed it has" (Jordan & Russell, 1999, p. lxxiv).

As an already historical habit, philosophy has demanded over the last decades the reform of its fundamental concepts in order to survive. Simondon accomplished this demand at its highest level[59]. Perhaps it is time for conceptual reform to be echoed in other fields of applied science as well. That is, to set aside the exclusive thematization of "agents" and rather to focus on their relations, to displace the concept of intelligence in order to ontologize thinking, namely, *to bring "intelligence" to an end* and enable the question of "thinking" as a product of

[58] This question was formulated in 1950 in his article "Computing machinery and intelligence". There Turing states that the answer to the question of whether machines can think would be either dangerous or even absurd and for less ambiguity he proposes the so-called "imitation game" or later known as "Turing's test" which is based on a Victorian-style competition. The game involves a communication between a human judge who is required to distinguish two others (man and woman) who are hidden on the other side of the desk, and whose communication is mediated by notes that pass from one side to the other. Then, the woman is secretly replaced by a computer program and the judge shall decide which one is the man. In the event that the program succeeds in tricking the human on the other side, it is said to have passed the imitation test. There are different interpretations as regards this game, one of them coming from the "father of Bayesian networks and Turing Award winner, Judea Pearl, who refers to it forcefully: "To fake it is to have it. That's what the whole Turing test is about. Faking intelligence is intelligence [...] and you can only fake it if you have it" (2019)." (Pearl in Prado, 2022). Another interpretation, coming from the computer scientist and media theorist, Javier Blanco (2020), explains that Turing does not intend to show here that a machine can think nor that it is intelligent, but that it has certain skills typical of the versatility of any computer program.

[59] This renewal of the fundamental and axial concepts of the field comes, in large part, from the influence Simondon receives from the field of physics, in its total renewal by the mid-nineteenth century. As Cassirer (1953) observed and Heredia (2017) analyzes, physics abandoned the "substantial" concepts of the eighteenth century to turn to the concepts of "functional relations" of the nineteenth century, thus transcending, formal principles in order to recast the basic notions of its field.

individuation itself rather than as a *goal oriented* mechanism between input and output chains. This is, still, to be interpreted and written.

1.3. The limitations of Simondon's notion of information

When the illusion about the existence of objects (substances) disappears, all the potential relations that constitute them sparkle and this is the very core of "being" in terms of becoming. No more agent nor environment, everything bears expansive *intelligence* at different levels, everything becomes *a state of mind*. This said, the concept of "intelligence" is a program that has become collective rather than individual in our times.

The domain of the becoming (the essence of information) (Sect., Part II, Chapter VI, § 1.) runs through a process of continuous variation, of intensive manifestation (ILFI, 265-272). Information, under these conditions, can not be understood in qualitative nor quantitative terms as foundationally established by the theory of information of Nyquist (1924), Hartley (1928), Shannon/Weaver (1949) or Wiener's cybernetic circle. On the contrary, for Simondon: "Above information as quantity and information as quality, there is what could be called information as intensity" (ILFI, 267). The patterns of energy transmute into signals and these into information, in a particular *state of mind.* Founding its ontological pretensions, for Simondon, information can't hold the values of true or false and instead, it bears the ontogenetic force:

> Matter can receive a form, and establish ontogenesis in this matter-form relation. [...] The word ontogenesis takes on its full meaning if, instead of granting it the restricted and derived sense of the individual's genesis [...], it is made to designate the nature of the being's becoming, that through which the being becomes, insofar as it is, qua being (ILFI, pp. 2-4).

For a contemporary Simondon's interpreter, Yuk Hui, Simondon's critique of the information theory of the 1940s is both an ontological and socio-political critique, he explains: "it proposes a new ontology of information while redefining its role in human individuation" (2015, p. 29, own translation). Nonetheless, Simondon captures the relational aspect of information shared between energy systems (*beings*) as a founding force while leaving their mathematical relation aside. This implies to leave aside not only the quantitative aspect but the whole of mathematics where: its formal (symbolic) language is transformed across its domains of necessity (theorems), possibility (models) and contingency (applications)[60].

Nonetheless, in one of his first writtings, *Épistémologie de la cybernétique* (1953), Simondon noted that mathematics is mostly based on an operation rather than on structures. That is to say, mathematics, like cybernetics and unlike the sciences with a unified object of study (e.g., biology or astronomy) does not have the primacy of an object of study (structure) but of functions and operative processes. "Mathematics [...] is first and foremost a method - of measurements or transformation of measurements. They provide the other sciences with operational methods" (EC, 177, own translation). This illustrates the epistemic value of Simondon's realism of relations «*réalisme des relations*» recovered by Bachelard (Barthélémy, 2006). Still, the mathematical vision is the *point of no return* between Simondon and Bachelard (not only on an intellectual level but also in their personal life), it is mathematics that tears them apart. Despite the fact that both can be channeled to the doctrine of relational and non-substantialist ontologies and epistemologies, Simondon considered inadmissible the similarity (isomorphic theses) between the mathematical reality and the effective reality while Bachelard, conversely, even considered mathematical reality as the most fruitful seed, the very creator of reality itself: "the creative power of mathematics to create reality" (Bachelard, 1984, p. 41).

Besides Simondon's anti-formalist position on mathematics (the formalist position can be mainly found in the foundations of arithmetic), there is no unified consensus on the view of information brought by Simondon. At the same extent, its ambiguity triggers no consensus between his interpreters about the pre-individual phase in which information significantly emerges and takes part:

> Information, for its part, pertains to the «pre-individual» preparatory to that passage. Information – Simondon is unambiguous about this – has no content, no structure and no meaning. In itself, it is nothing but disparity. Its meaning is the coming into existence of the new level that effectively takes off from the disparity and resolves the discontinuity it exhibits into a continuity of operation. Information is redefined in terms of this event. [...] The process is not susceptible to any stable formalization because it is continually giving rise to new operational solidarities that did not exist before, and therefore exceed all prior formalization (Boever, et. al., 2012, p. 32).

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[60] This is extended in: §1. *The concept of pattern in Simondon.*

A closer examination allow us to distinguish at least two sources of ambiguity around the notion of information: one is the inherited concept from Wiener's cybernetics[61] in which information is described by a negative definition: information is not matter neither energy[62] and it is opposed to entropy. The other one, is Raymond Ruyer's critical responses (1954) to Wiener's information machines, resembling that of Canguilhem's *Machine and Organism* (1952), later retaken by Simondon in "The Limit of Human Progress" (2010 [c. 1958]) and analyzed by Barthélémy (2005a), Bardin (2015) and Heredia (2017).

Ruyer responded to the, according to him, "unfounded analogies" coming from Wiener's early cybernetics who avoided the question about the origin of information and sought to establish illusory links of similarity between the information processes between the human and the machine. In his critique, Ruyer pointed to a key ontological assertion regarding the notion of information: information is not the sequential structures through which the machine operates but presupposes *unity of form,* and this is only achievable by a *conscious being* or conscious representation. In other words, the machine cannot see the form but the infinite segments that compose the form itself. Simondon will later take up Ruyer's idea to establish a very similar critique and analyze the epistemological category of *form* and *information*. Ruyer explains:

> Despite all the concerted willingness to recognize its elements of truth, the cybernetic conception of information is no less contradictory. In the transmission of a structure, from machine to machine, or from one part to another part of the same machine, a form is finally transmitted as a signifying unit, because a conscious being can be aware of an end result as a form. But the transmission itself, insofar as it remains mechanical, is only the transmission of a structure or of a structural order without internal unity. A conscious being, apprehending this order as a whole, turns it into form, but in the analysis, the transmission is operated in the machine by a progressive functioning or by partial and isolable functionings. (Ruyer, 1984 [c. 1954] p. 13, own translation).

[61] The plexus of references about metastability processes found in both Norbert Wiener and Gilbert Simondon can be a fundamental center of attraction to rethink automation processes as a phenomenon that does not exhaust its potentials through the deterministic and discrete veil assigned to the computational processes, but rather, the phenomenon of automation unfolds transformation processes with respect to information, which escapes its teleological, dialectical and deterministic view.

[62] Cf., Wiener, N. (2019 [c. 1948].

As already mentioned, Simondon carried out an in-depth analysis on Ruyer's critique and also attempted to banish the myths concerning the human-machine analogy[63], but unlike Ruyer, Simondon went beyond the mechanistic critique to cybernetics with the aim to activate the *transductive* convergence of each term, that is to say, their complementary aspect: it is the human being who provides the in-formation to the (open) machine[64] constituted by forms. "The living transforms information into forms, the a posteriori into a priori; but this a priori is always oriented toward the reception of information to be interpreted [...] the rate [*régime*] of the machine can be modified by information coming from the outside" (MEOT, 150, 154). Therefore, in its general sense, the machine is a fully indeterminate being which, when information is provided from the outside, a definite quota of determination is charged to its internal state.

The actively transforming and modulating[65] character of information makes it possible to relate it between subdomains. But most significantly, it places technical operation (information) on the horizon of the operation of being (becoming) in order to capture the tendency and potentiality of technical/living individual towards progressive and continuous differentiation[66]. In this sense, the simondonian *genetic metaphysics of individuation is a technology of becoming and growing differentiation.* But if, as Barthélémy points out, the terrain of individuation pertains to living beings, how does the *operative analogy* between individuation and information operate at the level of what Simondon called "technical beings"?.

When referring to technical beings Simondon made special emphasis on *information machines* (self-regulated behavior or "learning") which, despite being a novelty, as Guchet

63 Pascal Chabot also emphasizes this aspect: "He rejected the myth of the human-machine hybrid, the possibility of rationalizing human behavior, and other oversimplified conceptualizations" (2003, p. 53).

64 It was Bergson who inspired Simondon's notion of the *open/ closed machine* in his work: *The two sources of morality and religion* from 1932. With the notion of "open machine", introduced in his work in the late 1950s, (MEOT), Simondon defined it in the following terms: "the machine endowed with a high degree of technicity is an open machine, and all open machines taken together [*l'ensemble des machines ouvertes*] presuppose man as their permanent organizer, as the living interpreter of all machines among themselves" (MEOT, 17). On the influence of Bergson and Bachelard for Simondon's genetic ontology, see: Barthélémy, J.H. (2008).

65 See footnote 41 in order to understand the concept of modulation.

66 For this reason, i.e., the permanent differentiation that pertains to the fields of individuation, Deleuze took up from Simondon the concept of individuation as a key concept to shape his metaphysics of the difference of being. Cf., Deleuze, G. (1994). Also see other Simondon's concepts in following Deleuze's works: *Logic of Sense* (1993 [c. 1969]), *Thousand Plateaus* (1987 [c. 1980]), *and What is Philosophy?* (1994 [c. 1991]).

rightly points out, information machines or self-regulated machines are not the technical object that occupies the greatest interest in Simondon's writings. Besides the fact that information machines continually free themselves from their inventors (by increasing automation processes), they do not have true interiority nor exteriority (ILFI, 50; 314; 315) their evolutionary power is rather to be found in a more global structure: *technicity* itself[67]. The structure of technicity bears a potentiality from where the relationships between *form and information* derive.

Here we find that there is an arduous epistemological problem that Simondon omits when refering to *technical beings*[68] and that we inherit until today. This is, the association between ontological aspects (classification of states, properties and/or operations of being) with artificial cognitive entities (information, self-regulating or cybernetic machines) which formally lack the representational schemes of conscious experience as we already noted. Thus, the question worked by cognitive scientists and behavior-based approaches[69] since Wittgenstein

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[67] Simondon expressed:

> Technicities can be thought of as stable behaviors, expressing characteristics of elements, rather than as simply qualities: they are powers, in the fullest sense of the term, which is to say capacities for producing or undergoing an effect in a determinate manner (MEOT, 75).

A machine endowed with a high degree of technicity, of potentialities, that is to say, of metastability and indeterminacy implies three key considerations. *On the one hand*, it is a machine that perfects itself by virtue of its "internal necessity", where successive systems of coherence predominate (its own technicity enables this path towards perfection). More simply expressed, its evolution is not merely given by demands that result from its *use*, it is a consequence of its embedded technicity. As Stiegler claimed: "technicity itself derives from a process of technical individuation" (Stiegler, 2015, p. 117). *On the other hand,* each of the elements that compose the machine, when entering into mutual relations, finally determine an ordered assembly, but according to Simondon, this organization is not due to the materiality of the elements but, again, to their technicity, it is the intrinsic powers that constitute an associated milieu (*milieu associé*) defined by him as: "the concretization of the technicities contributed by all the elements, in their mutual relations" (MEOT: 75). *Finally*, and this would be the most important aspect, the *high degree of technicity* is equivalent to a machine that possesses a margin of indeterminacy (*marge d'indétermination*) in its functioning which allows, as already expressed, to receive information, readjust, and fulfill multiple functions.

[68] Cf., Lindberg, S. (2019).

[69] The problem of "cognition without representation" is analyzed by the AI german scientist, Josha Bach (2009), by opposing representationalist (Language of Thought Theory) to environmentalist schools of thought (behavior-based approaches): "Taken to the extreme, behavior-based approaches even become behaviorist and deny the

might stand out in a new manner: is it possible to refer to *technical beings* without including representation, or let us put it in another way, is it possible to address an ontology of machines without the "image of thought" (*Gedankenbild*)? This is a key infrastructural question for AI's foundational theories whose ultimate goal is to achieve the implementation of representation, the general purpose learning in-the-machine (borrowing Heidegger's dicta), that is to say, to endow it with abstract models of the world[70]. Most well-known attempts are to be found in: the Turing machine, Wiener cybernetics, Ashby's homeostatic systems, McCarthy's common sense programs, Newell and Simon's symbolic physical systems, the Bayesian networks of Judea Pearl, the deep learning of Geoff Hinton (Prado, 2022).

Again, back to the question of whether there is *individuation in technical beings* or «external theaters» as called by Schick (2017), our most straightforward answer is, Simondon, in fact, did addressed the possibility of individuation outside life itself, still, very briefly:

> It can then be asked if the veritable principle of individuation is not better indicated by the living being than by the technical operation, and if the technical operation could be known as individuating without the implicit paradigm of life that exists in us, since we are the ones who know the technical operation and practice it with our bodily schema, our habits, and our memory. This question has a large philosophical scope, since it leads us to ask if a true individuation can exist outside life. In order to know it, what should be studied is not the technical, anthropomorphic, and consequently zoomorphic operation, but the processes of the natural formation of the elementary units that nature presents outside the realm defined as living (ILFI, 33, 34).

What Simondon indicated in this passage can be read as an urgent warning: if we dare to seek for individuation in technology, outside life itself, we shall seek it first in *nature* where the formula for life *is-already* contained. Simondon considered the idea of: "if a true individuation can exist outside life" and, if so, then "what is this unity of nature". This is not

functional relevance of mental representations altogether, treating them as an irrelevant epi-phenomenon (Brooks, 1992; van Gelder, 1995; Beer, 1995; Thelen & Smith, 1994, p. 24)" Cf.: Bach, J. (2009).

[70] To endow the machine with a world implies to take into account Heidegger's pyramidal category of life-world regimes, that is to say, the worldless (*weltlos*), the world poor (*weltarm*) and the world-shaper (*weltbildend*). The stone is regarded as *weltlos* and the animal as *weltarm* in relation to the human. Cf., Heidegger, M. (1983).

drifting off, this is seeking in nature the source code of technology. This question had been previously addressed by Canguilhem, who six years before his student, wrote:

> Nature comes down to the identity of an element- «a single motor and a single subject» - whose composition with itself produces the appearance of diversity: «to vary its works infinitely.» [...]
> [The goal is seeking this single element to understand what] nature uses to diversify itself into complex living beings (Canguilhem, 2008, pp. 36-38, own bracketing with addition).

What Canguilhem underlined is the use of information made by nature. The elementary unit capable of varying its form infinitely is what the biologists of the 19th century called: the cell. This unit of nature draws attention for two important conditions: on the one hand, with respect to the type of control and regulation in the reproduction and variation of its forms, on the other hand, with respect to the capacity of its forms themselves to be technologically simulated[71]. Could this very basis of behavior of all vital processes indicate the pattern required for automating evolution in all technical beings? Precisely this type of development corresponds to the branch of artificial intelligence focused on biological evolution called (among other names) "evolutionary computation"[72]:

> Rather than focus on ourselves and attempt to emulate our own behaviours in cognitive processes, it would appear more prudent to recognize that we are products of evolution and that by modelling evolutionary processes we can create entities capable of generating intelligent behaviour. Evolutionary

[71] Prof. Dr. Capurro in his section entitled: "Towards a current interpretation of artificiality" argues in a clear manner on this:

> Traditionally, the artificial, a tool or a work of art, is less real than the natural. This concept changes in modern times, because the artificial (the machine) is being used mainly to dominate nature. But today we use a machine, the computer, not only to control but also to simulate all kinds of beings. This simulative capacity contributes more and more to a new sense of artificiality in its relationship to nature. Concepts such as virtual reality, artificial intelligence and virtual life are signs of this change (2017 [c. 2003]).

[72] For technical literature from this field also see: De Jong, K. A. (2006); Mirjalili, S., Faris, H., & Aljarah, I. (2019); Doerr, B., & Neumann, F. (2020).

computation, the field of simulating evolution on a computer, provides the basis for moving toward a new philosophy of machine intelligence (Fogel, 1995, xiii, xiv).

However, Simondon's focus on the process of individuation does not imply, as has been repeated for decades, that machines are becoming biological. Our answer regarding technical beings rather relies in the fact that finding individuation outside of living processes implies a "similarity of form" of evolutionary schemas[73] for pattern-creation: "evolution is not a perfecting properly speaking but an integration" (ILFI, 237). This is the object of concern in the next section.

§2. Crystal-based technology

On the brink of the organic and the inorganic, being and becoming, structure and novelty, the actual and the virtual there is a *cardinal example* of a superior level of individuation, namely, *transindividuation.* As chosen by Simondon himself, the very example of transindividuation is to be found in the process of *crystallization*. Crystals are solid storage technologies of *ancestrality*[74], the very stockpile of the records of the earth's evolution over billions of years ago.

The idea behind "memory crystal" is currently being explored as the most lasting memory storage technology that might has ever existed. While magnetic media (e.g., hard drive and tapes memories) degrades over time[75], the glass media, such as the case of crystals, may preserve data for milenia, even digital data as Microsoft's project *Silica* has begun to accomplish since 2017[76], their research team expresses: "A recent breakthrough at the

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[73] Kevin Kelly in his book *What technology wants* (2011) analyzes three common conditions in the evolution of all living organisms and technology: the trend towards *complexity, differentiation and socialization.*

[74] Cf., Prolegomenon, Chapter II, § 1.

[75] We already expanded on the history of storage methods and its pattern reproduction in: Sect., Prolegomenon, Chapter II, § 2., 2.1.

[76] On this, read the Microsoft Research paper from Anderson, P. et. al (2018) entitled: "Glass: A New Media for a New Era?". Where they explain:

University of Southampton has made it possible to store data in fused silica (i.e., quartz glass)" (2018, p. 2). Following the trace of evolution, crystals may also become solid technologies of *hyperhistory*[77]. The distinguished engineer, Ant Rowstron, in charge of the Microsoft Research Lab in Cambridge explained: "We need a fundamental rethinking of storage systems and the technologies underpin them. We think that glass is the ideal media for such a technology" (Rowstron, 2022, 0:50-1:00).

Crystal-based technology not only stores data, like all matter, although it seems to be static it is actually vibrating at a certain frequency. Its basic unit, the atom, forms a mass of vibrating molecules producing a special electromagnetic spectrum. Crystal is technology and vibrating energy, it is *transductive*. The structuring operation exemplified by the crystallization process is what Simondon recognizes under a fundamental concept named by him, *transduction*[78]:

> By transduction we mean a physical, biological, mental, or social operation through which an activity propagates incrementally within a domain by basing this propagation on a structuration of the domain operated from one region to another: each structural region serves as a principle and model, as an initiator for constituting the following region, such that a modification thereby extends progressively throughout this structuring operation. *The simplest image of the transductive operation is provided by the crystal*, which, starting from a tiny germ, increases and extends following all the directions in its supersaturated mother liquor: each previously constituted molecular layer serves as the

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> With cloud storage, the focus is on cost, and storage needs to be designed to be right-provisionable. The limits of what is possible with existing storage technologies are being reached, and a new clean-slate approach is needed for cloud storage. Hence, the time is right to seek out a new physical media to underpin novel storage systems designed exclusively to support the cloud. In Project Silica, Microsoft Research and Southampton University, are exploring whether quartz glass could be the future media for mass storage in the cloud (Anderson, et. al., 2018, p. 1).

[77] Cf., Prolegomenon, Chapter II, § 3.

[78] The notion of transduction is also presented in Simondon's following works: *Individuation in light of notions of form and information* (1958), *Form, Information, and Potentials* (1960) and *Amplification in the Processes of Information* (1962). For an introduction to the concept of transduction: Cf., Duhem, (2008); Leistert, O. (2018).

structuring basis for the layer in the process of forming; the result is an amplifying reticular structure (ILFI, 13, own italics).

For the French philosopher, what matters upon this geometrical array of minerals is the *structuring operation* that progressively extends. This structuring operation is a transductive one which does not imply the predominance of the form (of atomic lattice) upon the matter (of crystalline solids) but the relationship between crystal's structure and its function. And as the citation above exposes, transduction is exemplified through the crystal but it can also lead and give structure to systems of all kinds: physical, biological, chemical, social, and even mental ones. Transduction, as the highest phase of individuation, is a formula to in-form, de-form, uni-form, trans-form reality itself. A transductive system is a reality that resists identification.

Transduction, as Barthélémy (2021) explains, is a concept taken up from Piaget's stages of cognitive development[79]. It differs from both deductive and inductive operations and implies the correlation of unrelated events. The transductive operation, where thought itself is situated, contains a strong *apophenic* tendency, it creates patterns from the un-related. Simondon defined it like this:

> [W]e don't mean to say that transduction is a logical procedure in the current sense of the term; it is a mental procedure, and even much more than a procedure, it is the mind's way of discovering. This way of discovering consists in following the being in its genesis, in accomplishing the genesis of thought at the same time as the genesis of the object is accomplished. [...]
> Transduction is therefore not merely the reasoning of mind; it is also intuition, because it is that through which a structure appears in a domain of a problematic as providing the resolution to the problems posed (ILFI, 14, 15).

Along his primary thesis, he emphasized that the process of transduction is the latter phase of individuation just as pre-individuation belongs to the former phase. Still, it does not follow a chronological nor logical sense. As Heredia remarks: "transduction is the role model of the operation of individuation" (2017, p. 188, own translation). According to the aforementioned quote from Simondon, transduction is the key-operating term since it is the

[79] It is interesting to recall the fact that Seymour Papert, a pioneer in the field of constructionist learning, was one of Jean Piaget's favorite students. Cf., Boden (1978). Reigeluth & Castelle, (2021), particularly Chapter III: *What Kind of Learning Is Machine Learning?*.

“mode of discovery” of the thinking process just as it is the “mode of propagation” of the crystallization process.

Barthélémy explains: “The notion of transduction also enables Simondon to found a new thought of analogy” (2012, p. 230) and in a later work explains “an analogy which is not an identity between the technical and the living” (2015, p. 20). This analogy is not structural but functional, and this is what becomes his major method of analysis at all scales. Precisely this operation does not deem proof values of the inductive nor deductive type, it is intensive, mental, and intuitive[80]. This assumption leads us to question: with the transductive operation, is there anything else beyond “analogical paradigmatism”?. Simondon explained:

> Logically, it can be used as the basis of a new type of analogical paradigmatism in order to pass from physical individuation to organic individuation, from organic individuation to physical individuation, and from psychical individuation to the subjective and objective transindividual, all of which defines the plan of this research (ILFI, 14).

> Veritable transductive thought utilizes reasoning through *analogy* but never reasoning through *resemblance* [...]. Transductive thought establishes a topology of the real, and this topology is not identical to a hierarchization into genera and species (ILFI, 121).

Consequently, these notes point to the use of analogy as a methodological resource, but behind the analogy itself, what is defended in these claims is an integral and holistic vision underlying reality. The concept of transindividuation posed by Simondon may constitute an open call to ripe *being* beyond its system of meaning (*Sinn)* to what Hörl calls a *Sinnverschiebung* (2011), a displacement of the sense, of culture, the displacement of the hermeneutical treatment of anthropocentrism whose seat of authority is based on the meaning-maker subject. This does not imply the end of the sense of the human but “a new sense under technological conditions (*technologischen Verhältnissen*)” (Hörl, 2011, p. 7), not the end of the

[80] From his analysis of the concept of transduction in ILFI, Ludovic Duhem identifies that the same concept of transduction responds to three things that base the reality of being: "[1.] reality of a being in the process of individuation; [2.] process of the invention; [3.] foundation of a new “«analog paradigmatism»” (Duhem, 2008, p. 6, own translation, brackets are own adition). In this latter sense, the transductive operation is the hinge concept that allows analogy and *rapport* between activities between different domains.

subject but a new appearance of the same subject as written in the *Prolegomenon* section. In a certain way, Simondon demands a treatment of systems (physical-biological-mental-social) not through taxonomic categories but through a *common genesis*.

As noticed, Simondon distanced himself from the *structural analogy* and, as Barthlélémy points out, completely left it aside while focusing only on the *operative analogy.* Nevertheless, one can object that by omitting the analysis of structures, Simondon also left aside the role of patterns in the symmetry or asymmetry of crystals and, by doing this, he also left aside the mathematical aspect behind them[81] [82]. We will return to this later.

The discontinuity of the "degrees of individuation"[83] will depend on the types and scales of structures and energy, on local singularities and historical events (ILFI, 71, 72). This would explain how two individuals or elements with the same chemical composition can be at different levels of individuation, at different points of crystallization (physical individuals) or at different points of metastable restructuring (living beings as well as technical beings) while conditioned by the *milieu* in relation to itself. For example, the same molecules (i.e., the same chemical information) can vary to different forms: they can become a drop of water, they can become a crystal or a cloud of gas. They become different "individuals" according to how the pattern of those very same molecules is rearranged. So much the physical as well as the mental and the vital reality all of them depend on the rearrangement of information-patterns at stake. However,

[81] In his 1958 manuscript, *Allagmatics*, Simondon made clear that allagmatics as a "theory of operations" aspiring to be a "universal cybernetics" is systematized by knowledge such as; astronomy, physics, chemistry and biology. The omission of mathematics, within the theory of operations, is confessed later in the same text when analyzing the mathematical-geometric act as an act of structure and not of operation and where the: "[G]eometry and allagmatics take divergent paths from the very beginning of their activity" (A, 664). Guchet also understood that Simondon's program of unification not only of culture but of *des sciences humaines* in general requires technology: "technology, not only the science of machines, but the general science of operations of being, holds the key to the problem of the unity of the humanities" (2010, own translation). Also, on the universal cybernetics (*Cybernétique universelle*), see: Barthélémy (2014).

[82] So far, we can assume that both; mathematical virtuality and structural analogy are subject matters (which Simondon did not address) and that we shall pay attention to it in order to understand their key role in cognitive automated technology. And for what reason exactly? One could only oversimplify the idea behind this: the evolution of AI automated technology develops by means of the recognition of structures (patterns) derived from the virtuality of mathematical models (Sect., Appendix IX, §2., 2.2.).

[83] Other distinctions that lead to the same problem are found throughout an important distinction made by Simondon between "complete" and "incomplete" individuation. The former implies a full use of the energy contained in the system which leads into a *stable* condition while the latter makes a partial use that leads into a *metastable* condition.

there is something that Simondon omits here and that it may helps us to open the door to the fruitful seeds of the notion of *pattern*: if there are (physical) individuals with the same molecular composition and different states of individuation this is also due to the pattern in which its particles are rearranged and such a pattern obeys to mathematical relations[84].

In the case of the crystal, the formation of a crystalline solid takes place when the mother liquor containing the potential (physico-chemical) energy of the system undergoes a perturbation (it may be supersaturated or supercooled). That is, when the interior in a magma mass *solidifies* or when the compounds dissolved in a volume of saturated water *precipitate*. For this, two variables play the major role: temperature and time. Rapid mineral formation (rapid cooling of the magma or rapid precipitation) involves small, irregularly shaped crystals. On the contrary, a slow mineral formation would imply that the molecular structure has gained more space to expand and form bigger and more regular and periodic shaped crystals. This crystallization process illustrates the passage from a metastable state (the system has an apparent equilibrium) to a more stable state (the system became a solid): the final structure of the crystal.

Natural-formed crystals are self-assembled systems which have at least three qualities to be considered: first, they do not contain human intervention, second, they are able to self-organize chaos, and third, during this formation process they propagate by repeating certain patterns over their structures (crystal lattice). The structure of the atoms and molecular configuration of the crystal follow a certain pattern whose relations also correspond to a mathematical unit of measurement. Although most of the time the growth process of a crystal does not acquire a defined geometric shape (for which it requires much longer time duration and specific temperature conditions, solar emissions and radiation), in many cases, its atomic structures do acquire the shape of a mathematical pattern found in its geometric forms. For example, in an isometric (cubic) crystalline system such as iron pyrite, its iron sulfide atoms are linked, by force of their electrons, forming ninety-degree angles which, at a large scale, can

[84] Simondon's view only takes the mathematical sense of the concept of "relation" (consistent also with Bachelard) but marks a radical difference with a reality examined on the basis of mathematical relations. In this respect, Simondon can not be reconcile with all the "virtual platonist" current, including Bachelard himself, for whom mathematics not only bases reality itself but is an open, continuous and dynamic process or, as Cavaillès recognizes, a "becoming of mathematics" (Sect., Appendix, Chapter IX, §2., 2.2.). Heredia (2017) analyzes that the fundamental role of the resemblance of relations and not of substances, is recovered by Simondon from mathematics: "Indeed, as G. Cazals de Fabel will point out in a book read by Simondon, «the purest type of analogy is found in the mathematical proportion»" (p. 278, own translation). The mathematical proportion offers the analogy between their relations but not resemblance between the mathematical objects as such.

be seen in its cubic formed figure. Therefore, we can deduce that the symmetry between the faces of the crystals (which belong to the same group) responds to the numerical length of their axes. Following this, the crystal symmetry is described according to its space group, i.e., according to the ways in which its orientation (e.g., translation or rotation) can be modified without affecting the position of the atomic pattern. This is clarified in the next figure:

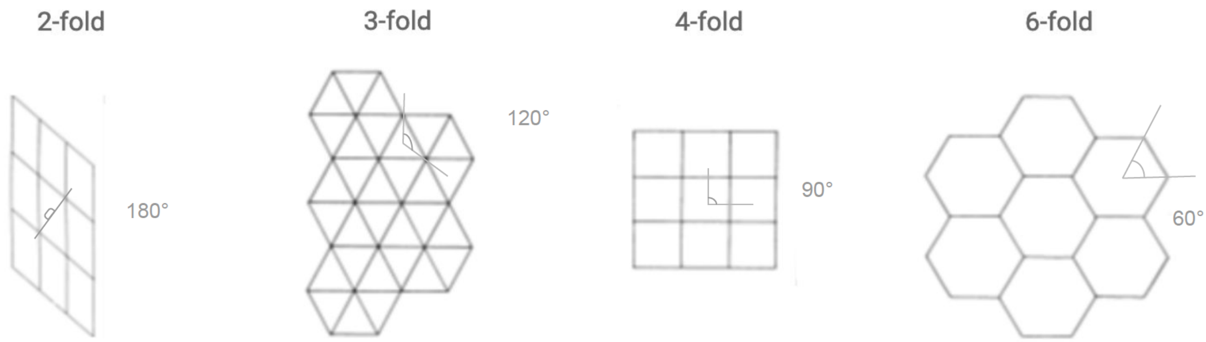

Figure 7. The only patterns (in rotational symmetry) that can be obtained from a crystal are 2-fold, 3-fold, 4-fold, 6-fold. Regular pentagons (5 fold) or an eight-sided octagon (8 fold) do not tile the plane. The mathematician and Nobel Prize in Physics, Roger Penrose, states a related mathematical theorem for this case. Also, he is well known for his solution to this problem, named, "Penrose tiling": non-overlapping polygons which can be reproduced infinitely and non-periodically without the pattern ever repeating itself. Non-periodic Penrose patterns were experimentally demonstrated in 1982 with the study of the so-called "quasicrystals".

On the question of how crystals are formed and the role of mathematics, an article entitled "Geometry and crystal symmetry" underlines the following:

> Although we know all the symmetries of entire systems of infinite patterns, we do not understand how these symmetrical patterns arise in a developing crystal [...].
> A crystal is not a geometrical abstraction, and geometry alone will not solve the crystal problem. Still, it has been shown in the last eight years that geometry has a great deal to teach us about the reasons for crystal symmetry" (Senechal, 1986, pp. 565 - 567).

Borges poetically claimed that the algebra is the palace of precise crystals[85] and since Descartes algebra and geometry became a *single corpus*, precisely, the mathematical patterns behind the (physical) crystal nests and correlates relations of a special type. We shall shift the argument for a moment. This bridge between physical formed patterns and mathematical underlying patterns is where we can bring Mark Hansen's observation on the missing links of correlation and co-transformation between mathematical and physical realms by describing it as the "*transductive* status of the noumenon":

> The "transductive status of the noumenon" thus designates the noumenon's dialectical correspondence with the phenomenon: the relationship between them -which is a relationship between potentiality and actualization- is primary in relation to either considered separately. One advantage of viewing the relationship this way, as an operation of transduction, is that it underscores the ongoing and continually morphing co-transformation of noumenon and phenomenon (Hansen, 2021, p. 54).

Hansen's critique (which begins from his reading of Mackenzie: *Machine Learners: Archaeology of Data Practice* (2017)) places the object of study of "machine learning" beyond two types of narratives: first, the forms of control, extraction, and accumulation largely associated with the new marxist literature on the capitalist capture of knowledge production (2021, pp. 25, 26) and second, the specific technical implementations and uses with which it is associated: recommender systems, (voice/image) recognition systems, and others. Against such narratives, which generalize (ML as a general operation) or reduce (ML as use-cases) the "techno-phenomenon" of machine learning, Hansen seeks, most notably through Bachelard's analysis of Kant's critique, to bring together and correlate the phenomenal and noumenal aspects of the local scientific phenomenon of machine learning. Ultimately, and this is our reading, Hansen's interest is to find the aspect of "contingency" and "uncertainty" behind what Bachelard called: *phenomenotechnique*. What is this for? Mainly to reinvent a critique of the subject whose reasoning became more-than-human (2021, p. 40). A critique able to prevent algorithmic operations (to which he alludes under Rouvoy's term as "data behaviorism") from

[85] Borges, J. L. (1960).

destroying the "space of critique", that is to say, to avoid the exhaustion of individuation[86] (from "dis-individuating" it) (Sect., Part III, § 2.).

Now, what is the *analogy* of the mathematical patterns of the crystals and those coming from technological operations? Just as there are mathematical patterns (axial properties) that correlate and, to a certain degree, "preform" the set of relationships of the *physical crystalline structure,* likewise, in the technological operations (for example, the case of the local practices coming from machine learning) there are mathematical patterns (vector functions) whose variables correlate and shape (in-form) the set of relationships between attributes while conditioning *the learning processes of the machine* (Sect., Part II). For different reasons and in different ways, *mathematical reality shapes transductive realities of different kinds*. However, to return to a previous citation by Simondon, *learning*, unlike crystals, does not become concretized, it always contains the potentiality for new individuations.

On this argument, the remarkable psychoanalyst, Carl Gustav Jung (who also worked on the concept of individuation[87]and had been recalled by Simondon himself in his study of the

[86] According to Hansen, "data behaviorism" leads to a reduction of the individuation process in three phases:

> [F]irst, data behaviorism reduces the given human subject to the status of abstract potentiality, dis-individuating it into a combination of infra-individual data points or elements and supra-individual (big) data aggregations; secondly, data behaviorism seeks to exert total control over the environmental dimension of individuation, such that it can command behavior, as it were "automatically," by procedurally sanctioning certain possibilities and disallowing others; thirdly, data behaviorism addresses relations, not individuals or subjects, but only in order to reduce them to monads, which is to say, to re-substantialize them as pre-constituted or "given" properties of the algorithmic system itself. In sum, data behaviorism, as a crucial part of a larger system of algorithmic governance, aims to contain, or indeed, to *quarantine* the relational force of individuation *within a single dimension or level* (Hansen, 2021, p. 30).

[87] Cf., Goldbrunner, J. (1949).

archetypal form [88] [89]) observed that the active role of the form (not the content) of the images found in the cognitive activity is comparable to that of the crystal:

> In order that it can be shown that a primordial image [*Urbild*] is determined as to its content, it is necessary that this image be conscious, that is, that it is already filled with material provided by conscious experience [*Erfahrung*]. On the contrary, its form, as explained elsewhere, can be compared to the axial system of a crystal, which predetermines the crystalline formation in the mother water *without possessing material existence [stoffliche Existenz] itself.* This existence manifests itself first in the way lotions crystallize and then in the way molecules do (Jung, 1995, p. 95, own translation, own italics).

[88] Without making it explicit, Simondon recognized the scope of the Platonic theory in Jung and evoked them through the concept: ideas-archetypes (*les idées-archétypes*) (II, 58). Simondon also drew similarities between Jung and Mircea Eliade through the very notion of archetype (II, 146): "the archetype is like a schema of the imagination, a mold of images that belong to the past of humanity (and perhaps to pre-human stages of the evolution of the species)".

[89] Pascal Chabot (2003) discusses the relationship between Simondon and Jung in his work *The philosophy of Simondon* and recalls Simondon's explicit mention of Jung in the introduction to *Psychic and Collective Individuation*. We are besides aware of his mention of Jung in the introduction of *Imagination and Invention* where he is mentioned to explain the motivational force of motor imagination (e.g., instinctive movements), and also in *Attitudes et motivations* (p. 385) where Simondon mentioned Jung to remind his individuation principle. Chabot quotes Simondon's mention of Jung in the following extract:

> Jung discovered, in the aspirations of the Alchemists, a translation of the operation of individuation, and of all the forms of sacrifice, which supposed a return to a state comparable to that of birth, that is, a return to a state that was rich with potential, but not yet determined, a domain for the renewed propagation of Life (Simondon in Chabot, 2003, p. 112).

Simondon's readings of Jung are present not only in his first thesis *Individuation...* (1958). Also it is present in Attitudes et motivations (1960b) and *Imagination and Invention* (1965-1966). In the latter, he elaborated on the role of motor images (swimming, flying, and others):

> Jung gave an interpretation of such images on the assumption that evolution had allowed images from living forms appearing in earlier phases of evolution (e.g. the dragon, which is related to the image of the reptile) to subsist in the higher species (II, 34, own translation).

Unlike Jung, Simondon omits this type of analogy where, as suggested above by Jung, the form predetermines the crystalline formation, that is, it plays an active role over physical matter (subsumed to a passive role). Simondon even recognized this in Jung's principle of individuation: "Jung's notion of individuation process can be applied here to individuals and to homogeneous ensembles of individuals" (AM, 385). As a derivation of the predominance of structure upon functioning, form responds to the best form, to the *good* form (*bonne forme*) and this drives to Simondon to formulate his critique on Gestalt theory: "Gestalt theory is an advance over hylomorphism, but it also fails to explain individuation, because it always supposes an equilibrium where individuation stops" (Hui, 2015, p. 35, own translation). This is precisely Simondon's *critique of the theory of form* (Sect., Chapter IV, §1.) where he introduced both Platonic and Jungian concepts in *Form, Information, and Potentials*: "structure is envisioned as the result of a state of equilibrium. [...] the archetypical form is the whole, the *Ganzheit"* (FIP, 686). Thereof, he called attention in order to replace the notion of form with that of information (ILFI, 16) and pushed at the edges the state of tension as well as of virtuality (both represented by metastable energy) of an individual (crystal) or of a system (technical) as a whole:

> If form were truly given and predetermined, there would be no genesis [...] Before the appearance of the first crystal, there is a state of tension that leaves a considerable amount of energy available for the slightest local accident. This state of metastability is comparable to a state of conflict in which the instant of highest uncertainty is precisely the most decisive instant, the source for determinisms and genetic sequences that find their absolute origin in this instant (ILFI, 258).

This implies that the *evolution of individuation* takes place through processes that both physical and psychic ontogenesis share in common, these are: *metastability* and *uncertainty*. Simondon thus leaves a clue to reflect in terms of the evolution of individuation more than individualization in technological systems. The very evidence of this clue was found already by Stiegler: "The evolution of the technical system forms the basis of the becoming of human societies and itself constitutes an individuation, in the sense defined by Simondon" (2011, p. 11). Yet, it is important to notice that the process of development and technological evolution is not related to the perfect automaton, it is related to the open machine[90], namely, the machine with such a high level of indeterminacy[91] that is able to integrate or even discover its *associated milieu* (Barthélemy, 2012, Hui, 2016).

2.1. Techno-genesis: the elements for evolutionary technology

Although belonging to different dynamisms, so much the physical individuation as well as the psychic individuation share a process of information in a metastable medium, a transductive modality of in-formation. In this sense, the vital axiomatic that brings together physical individuation with psychic individuation is the task ahead for the *evolution of automated cognition*. The crystal is an expression of physical individuation but it does not exhaust it, after its expansion, the crystal individuates, it halts in its form. The open processes of digital information filtered by automated cognition may be, differently, considered in terms of an open process of ontogenetic forms, that is to say, forms open to the process of discovering, producing, and modifying patterns in formation.

The act of recognizing and producing patterns from data fits the liminal place between physical ontogenesis and the simulation of vital processes of information. One of its crucial features is recognized in the high level of indeterminacy coming from the mathematical variables at play (Sect., Part II). When considering the open machine, Simondon pointed out that the margin of indeterminacy is what allows machines to receive external information and (re)adjust their functioning, as well as to be able to fulfill multiple functions.

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[90] Also Barthélémy concludes his analysis on the automaton as follows: "For Simondon, true technological progress therefore lies in the «open machine»: that is to say, in the machine which integrates into its functioning its «associated milieu» (2012, p. 208).

[91] Hui summarizes this in the following manner:

> 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 (2016, p. 186).

Therefore we can deduce that the axiomatic tension of any automated machine learning system (a machine that *learns*[92] without explicitly being programmed) lies between: on the one side, the capacity to individuate inasmuch as the (technical) individual increases its *capacity to solve problems* and, on the other side, the capacity to expand beyond the goal-oriented teleological mechanism, namely, its relational and open automatism. Automated learning is not only on the path of solving problems but on a *ouverte* path of pattern discovery and transformation. The following extractions from Simondon's main thesis describes so much the *solving-problem* aspect of individuation as well as the necessity of the *milieu* as the main defining aspects of the regime of information:

> [T]he individual is a transductive reality; through the span its active existence in the temporal dimension, it increases life's capacity to solve problems: the individual bears an axiomatic or rather a dimension of the vital axiomatic; the evolution of individuation (ILFI, 239).

> [T]he living being is itself a modulator; it has a power supply in energy, an input or a memory, and an effector system; the physical individual requires the milieu as a source of energy and as an effector charge; the milieu supplies information, the received singularity (ILFI, 225).

If we could bring this complexity down to an equation, it would be defined by: potentiality = problem solving capacity (transduction) + associated milieu (energy source). But when did Simondon address the concept of *potentiality* in machines or technical objects? Predominantly in "Supplementary note on the consequences of the notion of individuation" (1958), part of the MEOT, and in "Psychosociologie de la technicité" (1960-1961). The fact that cognition constantly extracts and mines past and future potentialities, as followed now by automated technology itself, obeys to the conditions of the existence of *potentiality*, from where the milieu itself evolves. In this quest to give access to technological evolution towards individuation itself, Schlick (2017) indicates that the technical object is already the milieu itself: "Technical objects are themselves individuals and milieus" (p. 55). Althought it remains as an interesting claim, this might not be the case. The milieu contains encrypted all the internal richness, all the potentiality, all the possible forms of organization of the technical object with

[92] Cf., Sect., Part II.

respect to it, but it is the technical object what continually seeks to resolve this problematic, and that's what all their mode of existence is about.

Simondon drew a study of the machine, neither as concretized (it reaches a limit in its evolution and halts there), nor as automaton (it reaches a final equilibrium in its information regime), but his genetic and evolutionary study corresponds to an open machine (*la machine ouverte*). He noted that *la machine ouverte* indefinitely continues its evolutionary process (increasing, integrating, and differentiating its relations) within its own milieu, even giving rise to functions for which it was not originally conceived (*hypertely*)[93]. Consequently, the ontological value of the (open) machine implies its growing capacity to multiply and make its relations more complex while starting from its own *limitations*:

> It is due to these relations, given certain limits of the conditions of utilization, that the object encounters obstacles within its own operation: the play of limits, whose overcoming constitutes progress, resides in the incompatibilities that arise from the progressive saturation of the system of sub-ensembles; yet because of its very nature, this overcoming can occur only as a leap, as a modification of the internal distribution of functions, a rearrangement of their system; what was once an obstacle must become the means of realization (MEOT, 32, 33).

In another order of ideas, the limitations of a certain paradigm of automation or automated learning are constitutive precedents steps of the next paradigm, since far from limiting it, they enable its evolution. This corresponds neither only to the extrinsic nor to the intrinsic relationships. Regarding the former, the extrinsic relationships, these are not based on how a set of pieces enter into a relation and communicate, nor on the laws of causes and effects of which they belong, nor on the mechanism of purpose by which it acquires meaning and utility. As for the latter, the instrinsic relationships, neither are they closed on the intrinsic mechanisms that can transcend the sensible data or the internal structures where the operations

[93] Pablo Rodriguez (2007) in his translation to Spanish language of *On the mode of existence of technical objects* clarified that the concept of *hyperthely* implies that something exceeds the purposes for which it was designed or intended (p. 71). This concept can be found in the Second Chapter of the mentioned work, entitled: "Hypertely and self-conditioning in technical evolution" (pp. 53-59).

take form. The open machine, as an individual, is an energetic system of information, a reality that organizes and evolves from its limits[94].

These observations seem to force us into recognizing that there is a great epistemological problem in dealing with the evolution of contemporary (*ouverte*) machines as a transductive process. For Simondon *an automaton* differs from living beings, crystals, and other physical systems because, formally, it neither contains preindividual nor transductive processes (growth and expansion). From where it also derives the fact that it can only adapt to the environment without ever modifying the ends for which it was designed as already explained in this chapter (Sect., §1.). Although this epistemological problem finds its very endpoint in Simondon, the break out is to be found in Jean-Hugues Barthélemy, one of the most important scholars of Simondon in the world today.

Barthélémy correctly recognizes that Simondon does not attach pre-individual reality to modern machines (2012)[95]. This implies that in their autoconditioning schema, machines can not have "an inventive function of anticipation" (Simondon in Barthelemy, 2012, p. 116). The machine *in toto* not only lacks pre-individual reality but Simondon explicitly denies them access to a transindividual reality. By doing so, Simondon sharply differentiated *transduction* from *transmission*. He himself wrote:

> One can call this progressive transfer, fed in energy by the change of local state at the very place where the transformation takes place, *transduction*. Such a process, captured here in an elementary case, is different from the *transmission* of information in the form of propagation of a mechanical disturbance or an electromagnetic disturbance; in transmission, the field traversed is not a

[94] For a non-individuated system, not concretized but in an open process, Simondon expressed that the individual can not merely be based upon its limits but it also emerges from its singularity:

> For the individual, relation has the value of being; the extrinsic and not be distinguished from the intrinsic; what is truly and essentially the individual is the active relation, the exchange between the extrinsic and intrinsic [...] It is only when the result of a completed (or supposed completed) individuation is considered that the individual can be defined as a being with an interiority relative to which an exteriority exists. [...]
> For it is in the relation between exteriority and interiority that the starting point of transindividuality is constituted (ILFI, 50, 315).

[95] Ibid., p. 115.

receiver, does not energetically relay the incidence of information, and does not change its equilibrium regime (API, 162) .

By referring to transductive phenomena in a continuous process of evolution (amplifying), Simondon alluded to *physical phenomena*[96] capable of reacting to signals or to incident information but he also refered to *psychosocial processes* (API, 163). Regarding the former, the example as already elaborated earlier is: the introduction of a crystalline germ into a solution (supersaturated or supercooled) that activates the metastability of the receptor, thus giving rise to crystallization (API, 161). Now, regarding the transductive phenomena in psychosocial processes, Simondon expressed:

> This model [transductive] is applied to psychosocial processes; in a certain sense, it enables them to be defined, since psychosocial phenomena are psychic in the sense that they have an input of a psychic, individual type; but they are social since they are propagated by transductive amplification, which causes them to pass from the individual dimension of the input to the collective dimension of the output (API, 163, own addition in brackets, own translation).

Central to these propagations is the milieu[97]: the significant axis of production of relations for technical evolution, the force that evolves and undergoes transformations. The milieu is not the *perceptive apparatus*, it is not the *neuronal representation* as a model, nor is it only the *formal-logical* transformation of symbols. The milieu formed and shared between systems in communication is what meets the conditions of potentiality, of common becoming. For example, Bardin, when analyzing Simondon, recognizes in the *symbolic milieu* the place of expansion for both culture as well as for technical evolution. He also refers to the "cultural milieu" in the following terms: "the «evolutionary potential» of the human species grows in this milieu by developing it at the same time" (Bardin, 2015, p. 208).

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96 There is also a relevant example mentioned by Simondon that should not be overlooked: "The propagation of the nervous influx is of a transductive type" (API, 162). Stimulation in neuronal activity involves the activation of one cell triggering the activation of others, modifying one state by another. The well-known Hebbian theory of the late 1940s organized the information modulating principles of neuronal activity and served as the basis for the McCulloch-Pitts model of the first artificial neural network (1943), although local and not distributed as we know them today.

97 The clear elaboration of the concept of *Milieu-Environment-Center* can be found in: Canguilhem, G., (2001).

Individuation, the formula of *information*, creates the illusion that the more technical objects are produced and the more differentiation they entail, thus, the greatest the multiplicity that derives from them. In fact, the anti-Leibnizian creed (Sect., Chapter II, §3. , 3.1.) constitutes its analyses on the basis of this continuous differentiation according to the (factual) specificity of each particular method. It might also be worth to consider the other way around, the essence of technology, its very *technicity* (see fotenotes 63 and 99), produces and multiplies technical objects for them to be reintegrated into their unity, into a common, progressively form-better image which we find expressed as a momentous into *Culture* as foreseen by Simondon (Sect., Part III).

This thread leads to epistemological and political implications: the automated processes work, in a sense as a program already embedded in the psycho-social structures. *En son fond, technology* only comes to place a mirror in front of the psycho-social patterns, to *reproduce and multiply the practices already automated within society itself*. The psycho-social structure does not become automated by increasingly automating more and more activities in all walks of life, work and language, but rather, society itself *is-already* an automated process by design. The contemporary automated algorithms might only come to reveal it, to bring down the veil.

Despite the multiplicity of techniques and modes of use of concrete technical objects (e.g., the transistor), of thermodynamic machines (e.g., the steam engine) or information machines (e.g., algorithmic self-regulating behavior) what interested Simondon the most was not a technological multiplicity accounting for specific use-cases but a systemic and unified understanding of technics[98]. This is not because the machines of his interest are similar in behavior, but rather, because he succeeded in endowing them with ontological value. As we

[98] Following this reasoning, one could deduce that mathematical methods running in computers (which are objectification of *technicity*) tend, in their progressive evolution, not to distinguish and differentiate themselves more and more from their own genesis. Technical objects (like being itself) due to its openness might follow the path towards unity, towards the return to the totality of its primitive unity where it fulfills the role of vital mediator: the linking between the human and the world. "Primitive magical unity is the relation of the vital connection between man and the world, [...] the mediation between man and the world is objectivized as technical object" (MEOT, 177). All technological phenomena, inheritors of technicity, seem to imitate this opening movement of rupture and openness towards unity. *Technology produces what being dictates to it*: processes of ordering and relations from the multiple to the general. The technological tendency to "opening for expansion" so well debated in Bergson in *The Two Sources of Morality and Religion* (1932) and followed by Simondon precisely imitates the movement of being. Sharing this Bergsonian perspective, the contemporary philosopher Jean-Luc Nancy describes it as follows: the movement of *being* which is itself the *open* (2003, p. 7).

explained it previously, he called this ontological origin *technicity*[99] which precedes and surpasses the objects, the species and also the parts (MEOT, 173).

[99] *Technicity* is a key operating term of the simondonian universe whose metaphysical basis is found in the third part of the MEOT. Simondon presented the unity of a magical-primitive world that contains and brings together *sacredness* and *technicity*, the religious form and the technological form, in a complementary and unifying manner. Technicity is born, as well as sacrality, from the separation, the *rupture* and unfolding of this magical-primitive unity. The primitive magical structure is a reticulative structure and the precise origin between figure and background. This makes clear the boundary between metaphysics and technology in Simondon, although not being expressly acknowledged by himself, it was a metaphysical stance what allowed him to structure technological conditions in its own right. That is why, for Simondon, the foundation of a technology lies in the hands of philosophy and not of structural determinism. Bardin emphasizes that: "Simondon repeatedly underlines that the hypothesis of a structural determinism of the technical structure cannot be assumed. The technical «structure» can only determine the conditions of possibility of an efficient insertion of technology in the milieu of social groups" (2015, p. 201).

CHAPTER IV

The ontological axiom:
Patterns in-form (give form) to reality

§1. The concept of pattern in Simondon

In the specialized literature about Simondon the use that the author has made of the concept of "patterns" has not been addressed. These include: behavioral patterns, morphological patterns, patterns of stimulation (e.g., visual), patterns of ordering, but of more interest here, Simondon went even so far as to speak of «*patterns of culture*» (II, 45) even using himself the english expression. The programmatic basis of these patterns were understood by the author as: "a collective imaginary projection in the form of mythical images" (II, 46, own translation). We have aforementioned the strong connection between Simondon's analysis of psychological-collective behavior and Jung's analysis of archetypal forms[100].

What do we find behind these *patterns of culture*? The psychic-collective behaviors that, as Simondon called it, generate a "projective amplification" of mental images in the face of primarily instinctive phenomena. Throughout one of the most enigmatics and cryptic works of Simondon, *Imagination et Invention*, he elaborated many examples of how certain basic instinctual behaviors (e.g., fear of hunger) can generate an "amplifying projection" or what is known in Jung as an "archetypal projection":

> In effect, to imagine the ogre, it is necessary to be hungry, and to be harassed by the desire to devour one's fellows, [...] The minotaur, the Morholt of the legend of Tristan and Isolde, the ghouls, etc., represent the result of the same projection at different times and in different cultural contexts (II, 45, own translation).

[100] Cf., Chapter III, §2., 2.1., see especially footnotes 88, 89.

This is an opening space of a problematic ground. In Simondon's analysis, *the patterns of culture* are modes of organization of mental images. Depending on how the images are organized, we obtain different *patterns*, but even more, we obtain a different representation of how something is rearranged in the world. This leads to the claim that perception manipulates, to a large extent, our behavioral-pattern schemes or as Simondon himself called it: *perceptual patterns*[101] (II, 73). Shortly after dictating the course dedicated to the study of the aspects of the mental image, *Imagination and Invention* (1965-1966) (II), Simondon dictated another one known under the name of *Perception and Modulation* (1968) (PM), which was later published as part of the author's incomplete notes. In both courses, Simondon emphasized the concept of *pattern* as the output of perceptual experience, in the first course (II), as a selective value, for example, visual patterns that function as specific stimuli (in this case, he gave the example of feathers in ducks which is a type of pattern that the female selects for fertilization), in the second course (PM), he emphasized on patterns that act as a mode of sense-making (instinctive modes of a primary type, for example, danger): "Commonly, the perception of a stimulation pattern triggers a certain reaction" (PM, 231, own translation). Behavioral patterns, which have their origin in explicitly instinctive behavior[102] (feeding, reproduction, fear of death, reflex, defense, and others), become cultural phenomena once they are projected as mental images, as models, also generally recognized as archetypes. When the stimulating pattern becomes abstract, it is when it enters the realm of the *cultural* and acquires a multitude of representations.

However, Simondon simultaneously rejected that all psychic projections (what we refer here under the name of "cultural features": belief, attention, fear, desire, and others[103]) have their basis in perception: "Such beliefs cannot evidently rest on perceptual experience. They can only result from a mental activity of pre-perceptual anticipation" (II, 43, own translation). Perception, which is a nervous and sensory receptive state, as noted by Simondon, does not exclusively control the psychic scheme of behaviors (from which cultural features are derived). There is one force, for Simondon, that operates at a truly disruptive and massive degree in behavioral patterns, that is, the *image*: "The intra-perceptive image always plays the role of the

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101 Perceptual patterns manifest themselves in various modalities: patterns of movement (II, 37), patterns of the principle of constancy, that is, of grasping of object-properties (II, 76), patterns as true keys of irreversible learning (*Prägung)* (II, 93), and others.

102 This pre-programmed, pre-formed character of instinctive behavior "does not require the aid of experience to give birth to already organized behavior" (CI, 288, own translation).

103 This is expanded along Part III.

model (*modèle*), of the «*pattern*» of greater generality to which the set of images is related as incident signals" (II, 75, own translation).

In *Perception et Modulation* (1968), Simondon described the progression from low level perception (stimulus-signal)[104] to the intermediate level (reaction to the signal) up to the higher level of perception, which requires a lesser degree of intelligence (unified, perdurable, and pregnant perception of the object, i.e. the distinction between *background* and *figure*). Although in all three levels, the pattern guides the behavior, it is at the last and third level, called "object perception: or third level of perception", where the pattern reaches the highest level of abstraction: the model or archetype. The pattern evolves from the individual to the collective; it is an evolution of forms of organization or as the author himself in a previous course entitled, *Cours sur l'instinct* (1964), referred to it in terms of: the "configurational nature (*patterns*)" (CI, 253). Simondon wrote later in this vein:

> The perception of class [capturing the general] should be considered as the constitution of archetype [...]. The perceptual segregation into figure-background would therefore require to be understood as the archetype of the living in relation to the inert milieu, then of the individual in relation to the milieu (PM, 237, 245, own addition in brackets).

From the emergence of more complex and abstract organizational patterns, "the mental image" or conscious representation takes place. This mental image corresponds to an amplifying projection (II, 49). Crucial to this analysis is the fact that the constitution of an image, model or archetype already implies an intense *affective-emotional* motor[105]. The cultural

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[104] In *Cours sur l'instinct* (1964), Simondon distinguished the stimulus at two main levels: it can intervene at a lower level as an agent (when they are physical or chemical reactions) or at a higher level as a sign (when they are perceptible units) (CI, 323). He further specified the latter idea: "Perhaps it would be appropriate to devote the exclusive use of the term *perceptual sign* to the designation of the type of *integrable* information, which corresponds to the true apprehension of an *object*" (CI, 326).

[105] For Simondon, the negative state of the image (*images dans la crainte*), such as *fear*, leads to the unfolding (*le dédoublement*) of the real while the image of positive states (*l'image dans les états d'attente positifs*), such as *hope*, reunites with the real itself. In the false duality between the internal and external worlds, as pointed out by him, the affective-emotive contents such as the «fear of death» (internal) stimulates the desire to turn to images such as, for example, the «image of the gods» (external) (II, 46-50). Or its reverse, the feeling of hope gathered in the divine. For the latter case, there is no dualism, neither one nor the other is internal or external:

features (primarily based on instinctive behaviors) which give place to cultural forms (patterns associated with these behaviors) become unfolded, expanded and splitted as a repertoire of mental images: "undoubtedly [...] the *forms of culture* subjected to a cyclical becoming are those that involve a strong load of mental images" (II, 26-27, own italics). The image of the future requires amplification, it cannot be closed within itself nor be entirely predictable. Images shall be, therefore, constituted as a gesture of diversifying efforts.

These mental images are based on the richness of a fundamental concept linked to them and which has become the capital expression of all contemporary technology: *anticipation*[106]*, the image of the future* (*l'image de l'avenir,* II, 54) or its most frequent derivative in all AI media and literature: *prediction*. In this sense, cultural forms, like anticipation itself, project and amplify its mental images through a structure (an "organized initiative" (II, 32)) that allows them to arrange the projected images in relation to, as described previously, the amplification of basic instinctual behaviors, and, on the other side, the future itself. Simondon recognized the anticipatory dimension in all cultural manifestations:

> It is not possible to evoke, even in a summary way, all the richness and diversity of the images through which different peoples have evoked the future life. [...] [T]he images of anticipation [...] It is a question there of a third reality, according to the expression that Edgar Morin used to characterize certain cultural and information transmission phenomena (II, 50, 51, own translation).

Ii is in the passage from the instinctive phase to the cultural phase where the abstract (archetypal) pattern is built. In the former phase, the pattern (a complex signal) stimulates or triggers a given behavior, hence the notion of "behavioral pattern". This automatism, which

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> Hope seeks ways and prepares a journey; the images of hope do not aim to separate in order to defend itself; they do not propose transcendence [...]: the divine can be there, *hic et nunc,* in the straw and on the wood, as on this board on which we lay our hands (II, 49, own translation).

[106] Accordingly, Simondon conferred to imagination the faculty of maximum deployment of the exercise of anticipation, image as motor anticipation without limiting it to the unreal or fictitious, but granting imagination the active role (owner) for the creative potentiality (II, 56). This potentiality is what Simondon discovered expressed in machines capable of adapting their functions to different purposes (what today, for instance, would be represented by the smartphone: camera, voice communication system, writing, calendar, notes, album, and much more): "These do-it-all machines abstractly reserve a perfect freedom according to anticipation" (II, 56, own translation).

Simondon associates with instinctive behaviors, is also transferred to the cultural sphere: the projection of mental images (collective and affective-emotive) contains a force whose potential set the "patterns of culture" in motion. The common background of a *culture* is the association and disarrangement of shared patterns within the psychosocial relations established in a given community. Consequently, in order to operate or manipulate a certain behavioral pattern it is necessary to return to the (affective-emotional) signal that initially stimulates it. For example, neuromarketing strategies incorporate these elements when operating upon the patterns of consumption behavior through the exploitation of affective-emotive variables, such as, the fear of being alone, the desire to be desired.

Patterns, derived from a continuous perceptual experience and projected mental images, also function as pre-compiled programs (i.e., already pre-installed) in the cognitive/operational system of individuals. In *Imagination and Invention* (1965-1966) and one of his previous courses *Cours sur l'instinct* (1964), Simondon also developed this idea (without the computational analogy). In the former work, he analyzed behavior around patterns of two types: hereditary (instinctive) and perceptual (triggering stimulus) and then labeled them under the expression «*patterns of culture*». Almost incidentally, he was expressing that the *pattern* works as a pre-installed program within the (operative) system, i.e., an endogenous grown that conditions perception[107] and then derives into inherited behaviors, such as the instinctive ones:

> Perceptual experience is directed by innate forms or patterns corresponding to the grasping of the meaning of situations according to the primary modes of danger, of food, of meeting a partner, of the behavior of descent or of submission for the social species [...] (II, 22, own translation).

> Instinctive behavior seems to be, in a certain way, programmed (*programmée*), automated (*automatisée*) by a central reserve of automatisms, of actonal sequences that intervene in the different phases of the consummatory act, and capable of appearing progressively in the course of ontogenesis (CI, 256, own translation).

[107] "There are therefore certain perceptual *«patterns»* that play the role of triggering stimuli." (II, 34, own translation).

Also along all works gathered in *Communication et Information* (1968), pattern and program are concepts that cooperate with one another. This can be noted, for example, in *Perception et Modulation* where Simondon provided besides a definition of *pattern as stimulus*: "synchronic organization (or temporal chaining) of stimuli that must be gathered together in order to activate a reaction" (PM, 220, footnote 24, own translation). That is to say, pattern as that which activates an already-existing operative program, as a signal that always unleashes the same reaction, the same behavior: "it is necessary to suppose that a program is already there, that the stimulant does nothing more than unleash it" (PM, 208, own translation).

This means that, for Simondon, pattern would imply behaviors to be inscribed in a specific "program" which can be found so much in the genetic-hereditary code[108] as also equally activated in the face of exogenous stimuli or at the level of memory: "at the level of memory, of a precoordinated program that exists virtually" (PM, 220, own translation). The French philosopher explicitly observed the «pattern of the movement» to designate perceptive behavior of a primitive type (II, 67). For Simondon, these behaviors are of a *virtual* nature. They do not occur through the influence of the environment but constitute inherent organizational schemes with an organic basis. In this use of the concept, the pattern is never acquired neither by training (biological dimension) nor by learning (social dimension) (II, 70, 71). These perceptual-primitive behavioral patterns are activated as an intermediary nucleus between the organism or individual and its milieu.

Also, in the second part of his main thesis (1958), Simondon made use of the concept of *pattern* to refer to the rearrangement of individuals and colonies. The difference between the collective (colonies) follows a *pattern of ordering* [109] as different from "individuals" who amplify their experience without necessarily adapting its form to any pattern-type. Although he did not make the concept of pattern explicitly as different or opposed to that of the individual, he described that *an individual does not follow ordering patterns* since it has the possibility of

[108] In the introduction to the *Cours sur la communication* (1970-1971), Simondon describes the exchange of information from the genetic code and the *milieu* as follows:

> Inside a pre-organism (comparable to a filtering virus) there is a information that constitutes the genetic code; it is this information that, thanks to transfer processes, collects in the milieu the chemical components that allow growth and stability (role of transfer RNA, messenger RNA) (p. 62, own translation).

[109] For this he took up the studies of the French zoologist Éttiene Rabaud and particularly in his analysis of reproduction (at the cellular level) in terms of regeneration. With this the French philosopher seeks the criteria of individuation in biological processes of individuated and non-individuated species (ILFI, 188- 189).

amplification which implies discontinuous, integrative and constructive propagation (ILFI, 188). The individual may also build a colony, but the amplification remains (ILFI, 227, 228). This pattern of ordering (where information and ontogenesis operate) is mainly guided by: on the one side, a morphological criterion (reproduction of the whole over the parts) and, on the other side, a functional criterion (they obey to an overall orientation) (ILFI, 167- 185).

Back to the former distinction, between the individual and the colonies, Simondon examined the next step: the ontogenesis of living individuals. It is at this point where he came the closest to the concept of pattern[110] : the *individuation of a pattern* retaken from Arnold Gesell's genetic psychology. From this source, also genetic-based, he described how the diverse functions of an organism are synergistically integrated into a unit that makes it possible to explain the pattern brought by the (somatopsychic) behavior of organisms. Putting together Gesell's arguments on patterns to its own theory of individuation Simondon wrote: "there is no first essence of an individuated being: *the genesis of the individual is a discovery of successive patterns* that resolve the incompatibilities inherent to the basic pairs of disparation" (ILFI, 229, own italics). Patterns are presented in this analysis as an expression of continuous ordering in the face of problem solving, not as the reiterative and the predictable. In other terms, the pattern betrays an inventive nature; that of the event of formation. Similarly, in an interview to Brian Massumi (2012) he explicitly recognizes the importance of the pattern in Simondon in connection with the *taking-form event* and not with that of *repeating* the form:

> Technically speaking, it is this return event of formation – and not the form – that repeats itself. It is less that a form is reproduced, than that an invention repeats itself. If the repeat inventions fall into a strict pattern of conformity with each other, it is necessary to explain the serial production of this resemblance-

[110] Having already made basic conceptual distinctions and connections around the notion of individuation and information in the previous chapter, it is pertinent to our analysis to affirm that despite the fact that the notion of pattern does not play a central role in Simondon, it is possible to detect a "pattern of creation" or "pattern of invention" that takes place with the technological and the transductive operation. This pattern can be represented as the unity of form or meaning (*Sinn*), the resolution of disparities produced by the repetition at the individual and psycho-collective level of synergistic meeting between structures and functions. For such a pattern, information performs individuation in the sense that it operates at different levels and different intensities, with an infinite capacity for variations and, through which, the individual at issue is not but becomes, and in that becoming, contains within itself, its universe of potentialities. These potentialities achieve a new horizon of restructuring in a continuous and open state of becoming. Thus, the field of individuation drives the constant and dynamic path of being as information itself while heading towards new possibilities within its domain.

effect. [...] Far from explaining anything, the reproduction of resembling forms exemplifying an invention is precisely what is in need of explanation (2012, p. 30).

Underlying Massumi's interpretation, there is the need to understand the collective repetition of the formation of the technical object. The repetition of an invention that specializes, universalizes and perfects itself over time, pushes, with all the diversity of its elements, the human need to bring the technical object closer to the cognitive scheme of the mind. That is to say, to reproduce the virtuality of its past events in the object itself so that it can operate on them. The distortion of the past events by the machine is what is called *predictability*.

Just as Simondon found the morphological and functional criteria to describe the regularity and grouping of the colonies, also in Gesell's genetic study, the pattern requires a structural and functional scheme: the structure of the individual that synergistically integrates diverse functions for the resolution of problems. According to Gesell's theory, the type of cohesion, assembling and symmetry of the pattern of behaviors does not operate within a rigid system but in a self-regulating fluctuation with the world that allows it to indeterminately amplify its maturation, development, and learning schemes.

These observations on the concept of pattern related to Simondon's thought, bring us to a paradox that can always be retraced farther back in history. Individuation can be hitherto regarded in terms of successive patterns, but first, patterns shall individuate, how can this be possible?: "one cannot explain a form if not from another form that is supposed to be already given (*structura omnis e structura*), the replication of the form or its transformation, yes, but not its invention" (Chateau, 2015, p. 23). Simondon had been very clear on this position, form theory (as that of Gestalt theory of form) also can not explain the genesis of forms, we come back to this in a few lines.

So where there may be the "absolute origin" and the "self-emergence" that Simondon claimed for invention[111]? Is this not the result of a repetition in the way forms are organized? The physics of information through (genetic or computational) codes produces a successive "formation of forms". In this context, Simondon's answer to the latter question can be specified as follows: the hereditary character of a previous form (e.g. genetic information) received by the individual is not completely predetermined but implies *a problem to be solved.* This is how

[111] Cf., Simondon, G. (2005): *L'invention dans les techniques.*

the individual himself, through his own genesis, becomes the theater of operations of individuation, that is, of the variation of one form into another.

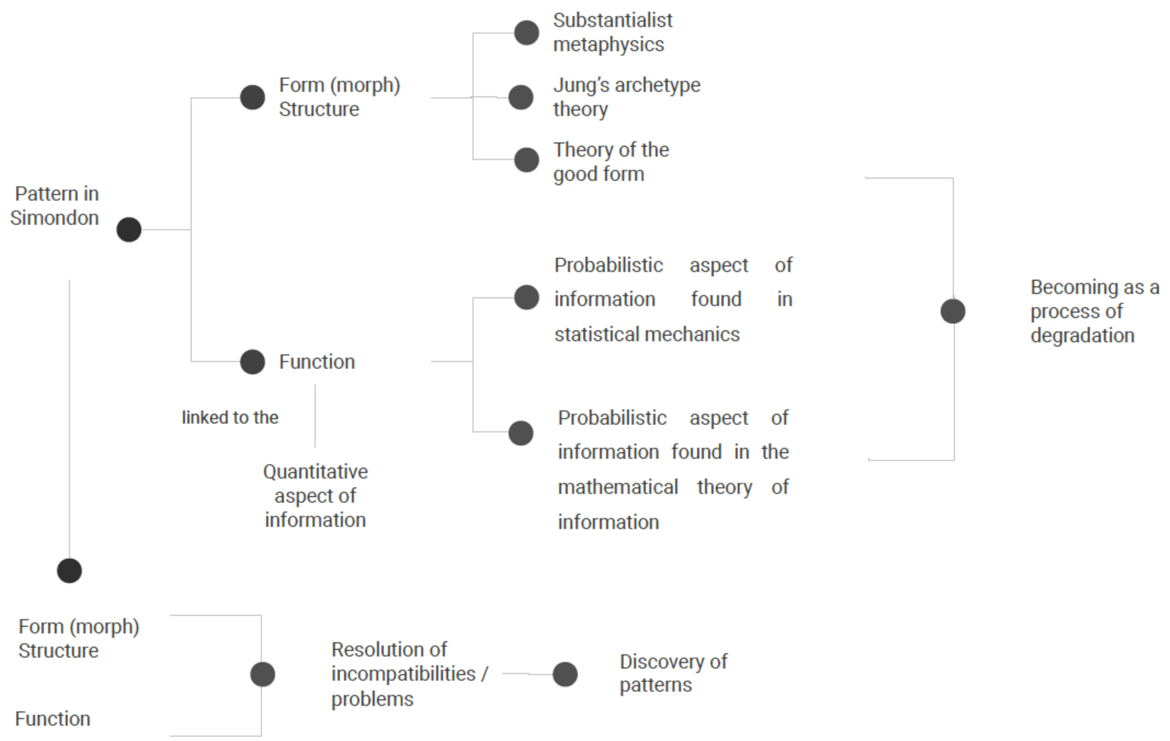

Figure 8. A layout of Simondon's observations on structural (form) as well as functional (mathematical) problems that can also be related to the concept of *pattern*.

The marginal and somewhat ambiguous space that the notion of pattern occupies in Simondon can be recognized at least for two major reasons: the first one is to be found in Simondon's critique of the "Theory of Good Form" coming from the Gestalt psychology and, the second one, in his resistance to analyze the information processes of behaviors in terms of mathematical expressions. The pattern is but the combination of both: it is a type of *form* that responds to *mathematical* models. As expressed by Bachelard: "It is mathematics that sets the pattern of discovery" (1984, p. 55). However, for Simondon, as we have seen through his recovery of Gesell's theory, patterns of discovery emerge from the resolution of incompatibilities and not from the virtuality expressed in mathematical relations and forms.

Back to Simondon's study of energy displaying the (living-nonliving) systems, if energy is analyzed in terms of an individuation process manifested between particles (physical individuals) and not in terms of the arrangement of its patterns, feasible of mathematical translation, promptly we meet Simondon's resistance to capture the behaviors (not only physical, but also biological and social) behind their mathematical expressions[112]. In his terms, this would entail a vision that subsumes the in-forming process of becoming into a system of rigid structures limited to the quantitative and probabilistic aspect of information (ILFI, 16-17, 265, 371):

> Instead of treating information as an absolute parameter that is measurable and quantifiable in a limited number of circumstances, it must be linked to individuation: there is information only as an exchange between the parts of the system that involved individuation, because, in order for information to exist, it must have a sense, and it must be received, i.e. it must be able to serve to carry out a certain operation (ILFI, 371).

Simondon's critique of the "quantitative", "inductive", "mathematical", and "probabilistic" character of information is primarily driven by his analysis on the *mathematical theory of information* (MTI) provided by Shannon in 1948 and then Shannon and Weaver in 1949[113]. It is Shannon who first introduced probability in the quantification of information[114] (Lombardi, 2019, p. 31). It does not drawn up on the basis of the semantic sense of information but of the electrical applications of Boolean algebra, i.e. a symbolic analysis of relay and switching circuits.

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[112] Mathematics has no place in the individuation processes posed by Simondon and this is reflected in the fact that rigid and axiomatic structures contain its object of study (mathematical object) in its own principles. For Simondon the objects of analysis can not be contained within fixed principles but in the genetic processes of becoming.

[113] In "Simondon et la question de l'information", Hui thematizes and problematizes the concept of information not only through quantification derived from Shannon, Weaver, and Wiener but also from later cyberneticians Donald MacKay, Lawrence Kubie, and second-rate ones such as Francesco Varela, Huberto Maturana, Heiz von Foerster (2015, p. 33).

[114] Shannon addressed the question: How to lower uncertainty in written language? By working on this problem, Shannon made a fundamental contribution to Natural Language Processing (NLP) and computational linguistics.

The MTI main problem is the measure of the channel's capacity to transmit information. The theory provides the passage from a signal to a received signal, from a transmitter (which encodes a sequence of messages) to a receiver (which decodes a sequence of signals). The most important aspect is the channel needed to transmit the message where entropy[115] defines the channel's capacity. The more probable a message is, the less information is contained in it and, conversely, the information received is very high when a message is less predictable. "That is, the more probable the message, the less information it gives. Cliches, for example, are less illuminating than great poems." (Wiener, 1989 [c. 1950], p. 21). This shows the statistical nature of the message and the fact that underlying information (set of messages) there is a statistical function. Behind its statistical nature are: the combinations, the varieties, the frequencies or infrequencies of its repetition, the average, minimum and maximum content of information, choice and uncertainty that is to say, the appearance of its patterns.

Wiener in his work *Cybernetics* (1948) stated that the fundamental concern of information theory corresponds to communication and engineering control over message transmission weather by mechanical, electrical, or nervous means. In the middle of the 20th century, this concern was concretized in technical objects such as the telegraph or the telephone, whose messages respond to statistical variation and regularity. Thus, he observed that the applied mathematical method of minimization (calculation of variations) for an optimal prediction of the message is what allowed the statistical shift of engineering communication: "we have made of communication engineering design a statistical science, a branch of statistical mechanics" (Wiener, 1985 [c. 1948], p. 10).

Hui writes: "Simondon therefore saw incomplete progress in the transition which led from hylomorphism to Gestalt theory (Form) then to information theory" (2015, p. 34, own translation). Simondon traced this problem through his examination (particularly around the studies of Louis De Broglie's theory of wave mechanics) on quantum and statistical mechanics. Mostly developed in the third chapter (*Form and Substance*) of the First Part (*Physical Individuation*) from his main 1958's thesis. Although Simondon recovered the methodological aspect of discontinuity/ quantum leaps from theoretical physics and adapted it to his own framework, he also denounced the probabilistic and indeterminate aspect of information

115 Computational applications are coextensive, hereditary and indebted to various fields, especially physics and mathematics. We must bear in mind that it is with statistical mechanics, and in particular its concept of entropy, that it was possible to apply it later to information entropy (Shannon) as a measure of uncertainty.

derived from it[116]. Regarding the latter problem, Simondon attempted to distinguish the concerns of MTI from the cybernetics led by Wiener. As Heredia (2017) points out, while the latter focuses on the engineering design of message transmission, the former is more concerned with processes of causal circularity. In spite of that, Wiener himself re-engaged the statistical study of information and related it, with maximum interest throughout his work, to inherently stochastic problems from physics:

> The notion of the amount of information attaches itself very naturally to a classical notion in statistical mechanics: that of *entropy*. Just as the amount of information in a system is a measure of its degree of organization, so the entropy of a system is a measure of its degree of disorganization (Wiener, 1958 [c. 1948], p. 11).

What Wiener underlines is that "entropy in thermodynamics is formally the same as the lack of information in the technical sense of the theory of information" (Sayre, 1971, p. 18). Information, therefore, implies a state of organization of a system, this state of organization and distribution is what is known under the name of "negative entropy", "negentropy"[117] or "the negative logarithm of its probability". Simondon's point of interest is precisely the concept that Shannon and later Wiener recovered from thermodynamics (Clausius, Maxwell, Boltzmann), that is: *entropy*[118].

Entropy has its initial moment from Bolzmann's research on Gibbs' statistical method with respect to the dynamic theory of gasses. This method had been applied to entropy: the approximate value of a state of distribution of gas molecules. These rearrangements or states of organization of energy known as entropy implies that the more complexity a system acquires, the greater its entropy level. We said that the mathematical theory of information analyzes the

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[116] Theoretical physics, according to Simondon, circumscribes reality within the duality of the type: particle-energy, wave-corpuscle, individual-medium. Simondon argued that this type of duality overshadows the pre-individual reality that, for him, precedes and gives rise to the structuring polarization of the real. This polarization is paired with what the Pythagoreans recognized under the name of the limit (*peras*) in the unlimited and indefinite (*apeiron*) (Sect., Appendix, §2.), notions that Simondon evoked from Anaximander and Plato's unwritten doctrine (*ágrapha dógmata*).

[117] In Barthélémy's words, negentropy, is an idea proposed by Léon Brillouin in 1956. Cf., Brillouin, L. (1956).

[118] Entropy starts with physics (statistical mechanics) and follows in mathematics. One consequence of the *Second Law of thermodynamics* is that the entropy in the universe always increases.

probability of a message state, precisely, where the distribution of a system is also presented. Following this, information operates with the opposite tendency, systems are organized not to increase their complexity but to decrease it so that the message does not consist of noise but of a clear signal.

Behind Wiener's statements is the general idea of the second law of thermodynamics where the universe tends to distribute energy in a balanced way, i.e., to increase entropy. One of its most well-known examples is that of the change of temperature of two metals in contact, one cold and the other one hot in temperature, and whose intensity of the heat tends to be distributed, decreasing the temperature of the hot metal and increasing that of the cold metal. Differently, information systems have a tendency contrary to that of the universe, i.e., to decrease entropy. As pointed out by Simondon: "The machine is that through which man fights against the death of the universe; it slows down the degradation of energy, as lifes does, and becomes a stabilizer of the world" (MEOT, 21).

Against the probabilistic aspect of information in theoretical physics, Simondon responded with pre-individual reality, the primordial state of reality. Against the probabilistic aspect of information related to the mathematical, physical and technical theories, Simondon responded with his concept of metastability[119]. At the 1962 *International Colloquium on Philosophy* held at Royaumont Abbey devoted to the concept of information, Simondon was among many leading scientists, such as, the greatest exponent of patterns and fractals theory, Benoît Mandelbrot. There Simondon presented: *Amplification in the Processes of Information* (1962) for which only a summary has been published. From the beginning, he placed as a key category the notion of metastability (rather than sender or channel) to analyze technological information processes. First and foremost is the receiver's metastability:

> To be or not to be information depends not only on the internal characters of a structure; information is not a thing (*une chose*), but the operation of a thing that reaches a system and produces a transformation. [...]
> The information receiver is a reality possessing a mixed zone of interaction between structures or local energies and incidental energy inputs [...].

[119] In view of the traditional metaphysical heritage, focused on ultimate substances (principles) that give meaning (derive) to the whole of reality, Simondon brought into his "philosophy of becoming" rather than "of being" not only a principle by which substances come into being but also, an "active receiver" that only reacts under conditions of metastability, that is, in a "polarized and potentialized" state.

> The *irreversibility* of the relationship between the incidental reality and the local reality rests on the initial metastability of the state of the receiver before the reception of information. This metastability guarantees the energetic autonomy of the receiver's becoming (API, 159-161).

> The fundamental condition for there to be information is not a particular state of the emitter, nor is it a property of the message, but a particular state of the receiver, which Simondon qualifies as "metastable" because it is charged with potentiality so as to make becoming-informed possible (Barthélémy, 2015, p. 36).

Thus we can understand that information is a continuous genesis: it is an operation that produces transformations, but where? It is the *receiver* of information (for example, a machine learning system), which is in a metastable state loaded with potentialities. Simondon's critique of the technological theory of information is based precisely on two postulates that follow from each other: on the one hand, to reduce the concept of information to its support or signals, on the other, to abstract the notion of information from the physical transmissions themselves (ILFI, 16). Thus the criticism that information "is not a thing", is not a substance, and that it must therefore replace the notion of form, becomes significative.

Besides the quantitative aspect of information based on the analysis of signals and noise is that of the "Theory of Good Form". Here Simondon drives to a partly psychological and partly perceptual type of critique resulting from his analysis of the concept of "form" (recovered from Platonic theory of forms, Aristotelian hylemorphic theory, and the psychology of form from the *Gestaltpsychologie*). For the latter, Simondon elaborated in greater detail on the Gestalt theory in his 1960 lecture: *Form, Information and Potentials* as well as in *Initiation à la psychologie moderne* (1965-1966), and in the third chapter "Recherches et théories modernes. La perception comme fonction et effect" of the first part of *Cours sur la perception* (1964-1965). The psychological form, following Gestalt's assumptions, is brought by the perceptual field which is able to reconcile the structures between the physical and the psychological, i.e., the stability (isomorphism) between physical (extrinsic) forms and internal (psychic) forms. Under Gestalt's umbrella, form describes a clear, homogeneous, simple, symmetrical, geometrical organization, an event that, following Simondon, would ignore the state of metastability[120].

Faced with this postulate, Simondon proposed the rupture of the perceptual field in terms of *figure/background.* The *Prägnanz* of the „good form" (i.e., geometrically recognizable) in the psychic apparatus ("its power to establish attention and to remain in memory" (FIP, 688)) is a consequence of its capacity to order asymmetries and achieve stability in the (cognitive) system. In other words, from the perception of patterns in data, the mind generalizes concepts (forms). The Gestalt school of thought has developed this idea through the so-called "law of completion" (*Das Gesetz der Prägnanz* or *Gesetz der Guten Gestalt*) and follows in this manner: from an incomplete figure, a meaningful perception of the complete form takes place automatically (see, Figure 9). Namely, it identifies the tendency of our cognitive apparatus to perceive the complete geometric shape (e.g., circle or a triangulus) when, in fact, there is none there (e.g., scattered dots).

Figure 9. Examples of figures (triangle and circle/ball) that comply with the law of completion in the Gestalt theory. Source: Wikimedia Commons contributors, the free media repository.

[120] This analysis equates the psychological spectrum of individuals with physical systems. A fact that satisfies the *second law of thermodynamics*, whose systems have the tendency towards a stable equilibrium, also strongly considered as inadequate by Simondon: "But this is precisely where the *axiomatic insufficiency* of Gestalt theory appears: structure is envisioned as the result of a state of *equilibrium*" (FIP, 686)

Cognitive psychology studies in artificial intelligence in relation to Gestalt theory (Gestalt Principle of Completion or Closure) led by Kim et al. (2020) highlight the sharp connection between the visual field (of vision systems) and the cognitive field (of shape recognition) by showing that AI can perform Gestalt's completion principle as humans do.

> Over the past decade, and particularly in the last five years, such deep-learning techniques have finally exhibited what Wiener liked to call *Gestalt*—for example, the ability to recognize that a circle is a circle even if when slanted sideways it looks like an ellipse (Lloyd, 2020, p. 9).

But what is behind the stability of the completeness of an image (i.e., of the Gestalt postulate)? To "close the gap" of visual elements or to "map out" objects does not merely imply to group the patterns together but even more it implies to be associated with an interpretation (e.g, the triangle figure). For human cognition, so much the clustering as well as the association of these patterns into "good forms" is an automated and subconscious process. This claim leads to the next question: why does this happen in artificial neural network automation using deep learning methods as well as human subconscious automation? Indeed, the means of artificial neural networks through which the in-formation takes place, always tends better towards generalization. In computational terms, the signals, the state of messages, the data, the numerical values, the statistical measure are all (technically) correlated in diverse manners to the idea of pattern. Mathematical and algorithmic automation, in this sense, are the methods to identify, produce and reproduce patterns *stricto sensu.*

The highest extent of this idea (on the tendency to *stable equilibrium* of the good form) leads, according to Simondon, to the death of both the spirit and the state of physical systems as a whole. In his lecture "Form, Information and Potentials" from 1960 Simondon addressed: "In all domains, *the most stable state is a state of death, i.e. a degraded state starting from which no transformation is possible without the intervention of an external energy to the degraded system*" (FIP, 687). This opens pathways. We shall see in the third part what the patterns may express about the cultural dimension. And precisely how the equilibrium of a system can degrade the becoming, the very sense of individuation itself.

1.1. In-forming reality through patterns

As we conceive it in its natural mathematical sense, i.e., the *ord*inary or *ord*-inal sense, the pattern refers to the arrangement of attributes in series or orders of a certain type. It is the "bracket" or "set" of the elements or mathematical objects of analysis within its specific limits. The pattern reveals forms and its attributes. The elements are directed, expanded or deployed into a greater type of order that manages to give form, viz., agglomerate them (uni-*form*) or enclose them (like a cluster).

Despite the fact that the concept of pattern has only been slightly taken into account and scarcely elaborated in the philosophical tradition, some of its possible primary lines of analysis can be identify in David Hume[121] (*Treatise of Human Nature*, 1739), Henri Bergson[122] (*Creative Evolution*, 1907) (both of these are levers with which Deleuze[123] elaborates his own metaphysical system of being as producer of ever-repeating differences, a system that would fit together with the very concept of pattern) and finally, Alfred North Whitehead (*Modes of Thought*, 1956, *Process and Reality*, 1960).

The general sense of the concept emerges, at least, in two different ways: as the *visible or common aspect in the diverse* (big patterns) or the *hidden or unfamiliar aspect in the evident* (small patterns). They can be observable or not but are still present. The pattern corresponds to a superlative mode of reality. When it hits the correct target, it produces the effect of order and alignment between perception and reality. The pattern-information expresses the tendency of being to a common arrangement, a justice of the form, in the light of its possibility of giving form, in-forming reality. When referring to the automation of mathematics, it is discovered in

[121] Focused on the structure of knowledge (how I know - *gnoseology*) and not on the structure of the world (how the world is - *metaphysics*) Hume studied empirically the very procedure of knowledge, which is neither inductive nor deductive but obeys a psychological pattern: to each impression corresponds a copy that is then reproduced in the mind as a (simple or complex) idea.

[122] Bergson turned to the notion of pattern and used it to explain our mind's habit of always linking the same causes to the same effects. With this he intended to describe the mechanical cause in mathematical and intentional terms.

[123] Founding its ontological pretensions, and complementary to this, Deleuze pointed out that the mathematical ordinal character does not order any units but ordered differences: "Ordinal construction does not imply a supposed same unit but only, as we shall see, an irreducible notion of distance - the distances implicated in the depth of an intensive spatium (ordered differences). Identical unity is not presupposed by ordination; on the contrary, this belongs to cardinal number and presupposes an extensive equality among cardinal numbers, a relative equivalence of exteriorised terms" (Deleuze, 1994, pp. 232,233).

the data and it is measured by an algorithm. An automated pattern-based culture, as a side-effect of the underlying mathematical structure itself, tends towards the general, towards the loss of individuation (which produces the difference itself), towards the compliance with a set of well-established patterns. Life itself is the sum of relationships between known and unknown patterns.

At the level of electrical, perceptual-sensory, logical, linguistic *signals* and their many derivations in other less formalizable fields, it is possible to recognize symbolic codes which are rearranged in terms of in-forming patterns. Similarly, Wiener in his work, *The human use of human beings* (1950), observed:

> Messages are themselves a form of pattern and organization. Indeed, it is possible to treat sets of messages as having an entropy like sets of states of the external world. Just as entropy is a measure of disorganization, the information carried by a set of messages is a measure of organization (1989, p. 21).

In other words, symbolic code is no other than another expression of patterns of order and production of complexity out of chaos. This operation matches with the *logic of control* between reality and perception. The importance of patterns is capital in all the areas that conform the image of the real or what Simondon called the "mental image"[124]: it does not necessarily require the reflexive experience but the association triggered by memory in order to take place. In other words, establishing patterns entails far more than an indefinite form-reproduction, it also involves remembering past sequences in order to be able to predict future ones. It is in fact, probabilistic in nature.

Its many areas of development are highly extensive and, most importantly, technically specialized: AI, cognitive science, psychology, and neuroscience, to name a few. This causes the pattern to emerge in different ways under different circumstances and for different contexts. Some of its manifestations can be roughly recognized so much in the human cognitive architecture as well as in the AI cognitive architectures, some of them are also a "reverse-engineer" processes. The following examples aim to capture some of the patterns presented in

[124] The mental image-memory is what Simondon identified in *Imagination and Invention* (1965-1966) as "symbol" insofar as it tends towards association with past events (e.g., a flag for an old combatant) it acquires the character of a search towards its primitive unity: "the symbol is nostalgic, it tends towards the milieu in which its attendant is situated; it involves a tendency towards the reconstitution of the primitive unity" (II, 5, own translation).

different cognitive functions, under different circumstances and with different characteristics in both cognitive individuals, namely, human and machines: 1) Patterns at the electro-signal processing level (physical magnitude), 2) Patterns at the perceptive-sensory level (neuronal arrangement), 3) Patterns at the abstract-operative level (genetic stages), 4) Patterns at the linguistic level (sequence prediction), 5) Patterns at psychosocial phase (sub-symbolic level). For clarity in exposition, (H) at the beginning represents patterns at human dimension level and (M) represents patterns at machine dimension level although both may be continually correlated or even omitted if necessary.

1) Patterns at the *electro-signal processing level* (physical magnitude):

(H): Patterns presented in the *electrical activity of the biological brain* and measured in terms of “neural patterns” (waves and frequencies). The synchronization caused through the sum of electrical firing of a group of neurons allows the pattern recognition of wavelike nature mostly known as “brain waves”. The latters are distinguished in terms of frequency and amplitude ranges (gamma, beta, alpha, theta, delta). The electro-signal level patterns occurring in the brain, are still under review for the next generation of automated learning applied, for example, to self-driving cars[125] (2019) and robotic prosthetic devices (brain-computer interfaces/BCI)[126] (2018). The electroencephalographic recording of brain electrical activity using electrodes as instrument of measure helps to obtain, for example, the sensory inputs of a race driver (visual scene and attention) or a patient’s sensory input (muscles electric activations). The data of neurobehavioral patterns can later be inputted to artificial neural network applications.

(M): At least three types of patterns are presented for basic coding signals in physical layers for machine communication in networks: the patterns of electrical pulses coming from electrical signals, the light patterns of optical fiber, and the patterns of microwave transmissions of digital (wireless) signals. In computer networking the physical layer is the hardware-level function that supports other upper layers responsible for the data packets to be transmitted. It is the underlying layer of any network and it converts (decodes/encodes) signal into binary transmission. Therefore, the very fundamental structure on which the complex upper layers,

[125] Cf., Lima, I. R., et. al., (2019).

[126] Cf., Di Palo, N. (2018).

where data is finally represented and applied, are assembled and interconnected is made possible by how the streams of bits are grouped in terms of patterns[127].

The differential capture of incident signals (II, 22) in the nervous system as in electronic systems constitutes one of Simondon's recurrent objects of analysis since there is not merely a situation of transformation of signals into measurable patterns but rather an adaptation of the entire system itself resulting in the reorganization of its internal structures and functions.

2) Patterns at the *perceptive-sensory level* (neuronal arrangement):

(H): Patterns presented to the macro-anatomical brain structure called "fusiform gyrus". It is responsible for the *pattern recognition of faces, shapes and places, and others*. Distorting the electrical brain signals (as proved by Stanford University in 2011 by electrical brain stimulation performed with temporary implanted electrodes) causes the misalignment between reality and perception: patients perceived the observed faces in state of metamorphosis[128]. The information, consequently, is primarily organized on shapes and their parts: words, faces, figures, elements. Regardless of the aforementioned study, pattern classification methods have corroborated this claim (Hirshorn et al., 2016) from their neuropsychological and electrophysiological data analysis obtained from the electrodes.

(M): Pattern recognition using machine learning techniques: corresponds to the identification, extraction, evaluation and prediction of patterns in vast but limited amounts of data (called "fitting" or "model training") by algorithmic models. *Machine learning usages in pattern recognition of forms: faces, shapes, places, and others* implies that the connection weights in the network have been modified (by a weight-adjusting algorithm) when a function approximates a response between a set of input and output patterns (Mareschal & Schultz, 1999, p. 153) (Sect. Part II). This procedure requires an optimal exchange of various operations that occur at the theoretical level (theoretical models) in combination to the empirical level (explicit implemented computational models). In general, all these diverse but complementary functions are restricted or condensed within the concept of *learning*. "Research at MIT has also shown that the underlying function of visual object recognition models matches the organization of

[127] Cf., see the reference model for network protocols, called "OSI model: Open System Interconnection". See also, Day, J. (2007).

[128]Cf., Goldman (2012).

the primate visual cortex, even though those computer models were not specifically designed to mimic the brain" (MIT, 2021).

Just as the learning of organisms consists in trying to adjust itself to the outside world (Goldstein 1971, in Canguilhem 2008, p. 9), so too algorithmic learning is the mathematical attempt to adjust data to a model of the world. This attempt is not, in the first place, perceptual-motor driven, but is based on the reconciliation of certain mathematical functions that respond to a given database (Sect., Part II). The objective of automated pattern capture is not only the recognition of well-established forms (classification), but most importantly, the simulation of the future (prediction). Beyond its technical particularities and highly complex mathematics, these data classification methods can be traced on: the *regression method:* linear, polynomial and logistic, on the *artificial neural networks method:* perceptron, layers, backpropagation and SVM (support vector machines), as well as in the most advanced chapter of automated pattern recognition: *deep learning*.

3) Patterns at the *abstract-operative level* (genetic stages):

(H): In Jean Piaget's genetic structuralism[129] (key axis for Simondon's genetic and symbolic studies), the cognitive development of a child is described in four restructuring stages (sensorimotor, preoperational, concrete operational and formal operational). The first evidence of abstraction and logical classification for the arrangement of patterns (seriation or sorting) occurs in the third cognitive stage (concrete operational, between 7 and 12 years of age). "According to Piaget, stages are periods of consistent behaviour reflecting qualitatively different modes of information processing" (Mareschal & Schultz, 1999, p. 151). This hierarchical classification of objects according to their quantitative and dimensional patterns (e.g., length or weight) responds to a genetic structure. That is to say, this third stage in a children's cognitive development does not arise randomly nor is it possible to identify its starting point and succession. It is a genetic procedure. Genetic means: a successive and exchanging relationship of developing structures[130]. The cognitive structure, as identified by Simondon through Piaget, is genetic in a transductive and non-sequential sense.

[129] For a clear and complete guidance throughout Piaget genetic's theory: Cf., Flavell, J. H. (1963).

[130] In *Imagination and Invention* (1965-1966), the cycles of development (genetic/ ontogenetic) are described as follows:

(M): Since it is not still observable how precisely the genetic stage arises, the patterns for seriation (sorting) tasks can not be followed by restructuring genetic stages as that of the child. Still, in automated algorithms this can be contemplated by their models and computational limitations. For example, by symbolic computational models, mainly of the type if-then rules (Baylor et al., 1973; Frey, 1964; Retschitzki, 1978; Young, 1976) as well as by connectionist network models (Mareschal & Schultz, 1999). Nevertheless, beyond the desired target outputs that a supervised learning can address, the next step on training data, which is unsupervised learning, is not even based on learning a concept and constructing a hypothesis to approximate the target concept based on instance attributes but on *finding patterns between relations exposed by data*. This case can become evident particularly in the latest chapter of deep neural networks: Geoffrey Hinton's capsule networks research involved in Google's Brain Laboratory. This may drive to the conclusion that it is not enough to look at the patterns that are predominantly configured through computational means, it is necessary to look into the mechanism of relationships that assemble and disassemble abstract-operative patterns.

4) Patterns at *the linguistic level* (sequence prediction):

(H): One of the key features of language is its organization through the repetition of structured sequences. There are many patterns (logical and intuitive) that shape language and its modes of transmission (both written and oral ones), but it is the analysis of probabilistic word processing, i.e., human neural data (brain measurements), that stands out most in recent research (Schrimpf et. al., MIT, 2021)[131]. Probabilistic language learning relies on prior sequences for the prediction of the next word. That is, for example, the likelihood that a consonant is followed by a vowel is higher than by another consonant.

(M): Detecting this pattern has led to the development of one of the most important AI stochastic models, the Markov chain model. In addition to sequences of letters, these

> [T]here are gaps (*déphasages*) in each of these partial growths in relation to the others, and different speeds, especially in complex organisms, so that it is difficult to specify the moment in which an organism arrives at the complete adult state; on the other hand, growth and development manifest stages and cycles, separated by transition periods where a dedifferentiation is carried out followed by a reorganization (II, 18, own translation).

In the same work, Simondon retrieved to Piaget in his work "The formation of the symbol in the child" of 1946 to distinguish *symbol* from *image* and the functions of accommodation and assimilation (II, 130-131).

131 Cf., Schrimpf, M. et. al. (2021).

probabilities can be applied to sets of letters and even more, to the probability between sequences or strings of words. This probabilistic and neural inspired approach has been the source of influence for diverse machine learning models in fashion: GPT3, Bert, Elmo, LSTM recurrent neural networks, and others. The acquisition or probabilistic learning of such language sequences allows not only predicting the next word but also generating a whole new sequence within the domain (recognized under the name of: generative models).

5) Patterns *at psychosocial phase* (sub-symbolic level):

The evolution of patterns is amplified throughout the radius of the various cognitive and motor functions. Starting from the perceptual experience of stimuli and reaching its highest peaks of complexity with behavioral patterns. The patterns evolve by accessing from the perceptual channel and reach the most complex stages of the individual and collective psyche. Following this claim, *patterns are not static but genetic.*

In computational terms, as previously noted in more detail, patterns also take shape from signal transmissions (electrical, optical, digital) and scale to more abstract (virtual) layers where new gatherings of data structure give rise to more complex program behaviors. These computational behaviors have increasingly evolved (in their different and specific tasks) according to the relationship that these patterns present.

Now, when referring to the cultural peak of pattern evolution, that is, behavioral patterns, the history of the relationships between patterns of behavior and computational-mathematical patterns cannot be narrated in terms of a chronological, linear and progressive history, it is a relational event, perhaps even a genetic one. Here we return again to Simondon. This relation shall be understood in genetic terms and within the context of the psycho-social phase[132].

According to Barthélémy's analysis on Simondon, psychosocial is "a reality in which the *individual* psyche is paradoxically developed *on the basis of the collective*" (2012, p. 111).

[132] One important methodological demand might be applied to this. Not to accept the postulate of theoretical-methodological reciprocity between the social and the psychic, hence the psycho-social, is to raise artificial problems and splittings (*dedoublement*) that, in fact, do not exist. A psychological analysis of behavioral patterns without the background of the social framework and its associated historical context lacks a true understanding of the set of collective practices that make up the groups themselves. In the same way that a social analysis without taking into account the psychological-cognitive perspective misses the evolution and dynamism of the relationships that allow the transformation of the same behaviors.

Here the paradoxical aspect refers to the impossibility of inscribing this phase within the immanent nor the transcendent. It is transindividual[133]. The common ground between the two is what we mean by Culture. The psycho-social is transindividual. This means it bears future individuations (potentiality). And, Culture, by itself contains all the possible elements, combinations, relations of these attributes. Culture is an *Aleph*[134]. For this reason and as already written, *mathematical automation or AI plays its most important battle in the cultural field*. Culture is where all patterns are formed, deformed, standardized and transformed (Sect., Part III). The open question is: how can patterns articulate the relation between the psychic and the collective?. The psycho-social is the utter patterning of patternings[135].

Many complex elements come into play for this analysis. We already argued that patterns are not static but that instead, they are genetic, they evolve. A label such as "anti-pattern" is therefore not of our interest, or even more, it is meaningless. Pattern-evolution, starting from perceptive orientation, reaches a higher level of pattern formation as found in the psychosocial field, this is precisely what Simondon noted under the expression «patterns of culture» (Sect., Chapter IV, §1.). This higher level of pattern formation might be recognized nowadays as "patterns of behavior" which hides the vital role of culture itself. But, again, how patterns operate between the psychic and the collective? Merleau-Ponty wrote it clearly (see footnote 136): "the symbolic system, the pattern, would be a social thing". The symbol precisely condenses what the milieu amplifies which is why perhaps Bardin (2015) recognizes it in terms of the "techno-symbolic-milieu".

That symbolic reality is not primarily semantical but numerical. It is not an accidental gesture that mathematics expresses the deepest part of the human *unconsciousness* (this interpretation had been taken into account by Poincaré, Hofstadter, and Minsky as well), for example, by predicting trends in *desires* of the consumers. It is also not an accidental gesture

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[133] A whole description of transindividuation has been developed in the previous chapter.

[134] This refers to the Argentinian writer and poet Jorge Luis Borges tale: *El Aleph* where all of reality is condensed at one encompassing and universal point.

[135] Here is how Merleau-Ponty had foreseen it:

> The perceptive orientation of the social field is to take literally what Lévi-Strauss offers as a metaphor. As the thing perceived is a principle of lived cohesion without being an essence, thus the symbolic system, the pattern, would be a social thing. (Merleau-Ponty 1954–1955, p. 121 in Bardin, 2015, p. 158).

Also see Guchet's analysis on the influence of Ponty on Simondon's literature: Guchet, X. (2001).

that algorithms can capture it. And it is not an accidental gesture that sub-symbolic reality (that non-conscious attention) is now being used for the prediction of users' desires and coined as "attention economy" (Sect., Part III).

This symbolic transmission achieved by mathematics is the reason for Badiou to recall the poetic and obscure Lacan's *matheme*: "Mathematical formalization is our goal, our ideal" (Lacan in Badiou, 2005, p. 67). If the ancient (Pythagorean-Platonic), modern (Galilean), contemporary (Cantor-Gödelian) assumption of a based-mathematical substratum of reality[136] is accepted, any later-borned cognitive individual (living or artificial) can be regarded as instantiations of a prime mathematical reality, cognitive instantiations able to create a dialectical *rupture*[137] (e.g., between figure and background), extract and process data from the very primitive unity of mathematical reality itself. Following the path of evolution in automation, technology and nature may finally become cognitive instantiations able to create a *rupture*, extract, process, translate and interpret data from this very source.

Lacan put it in a nutshell when he stated: "The symbolic world is the world of the machine" (1991, p. 47). Even more important is the fact that, for Simondon, the technical object should not be simplified either as an instrument of mediation, or as an object of art. The

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[136] It is interesting to notice that the ontological principles behind the universality of mathematical objects are organized within pure models or structural schemas which resemble the function of axioms. Behind modern theories of formalization of mathematical structure the mathematical forms take the place of the archaic Platonic (*εἶδος*) or as specially Jung understood, the collective archetype (*αρχή*). A platonist mathematician, such as Lautman, gives an account of the relationship between mathematical theories and an ideal (Platonic) reality:

> We only wish to indicate here the Platonic conclusion that these researches seem to us to impose: the reality inherent to mathematical theories comes to them from their participation in an ideal reality that is dominating with respect to mathematics, but that is only knowable through it (2011, p. 30).

[137] This significant *rupture* implies the configuration of dyadic schemes found in reality (technicality-sacredness, action-emotion, science-faith, left-right hemispheres, and so forth) (MEOT, 173-211; ILFI, 265-282) within which the psychic life is also modulated. Even though for Simondon the individual is crossed rather by transduction than a dialectical process he himself expressed, how sensations become ordered according to a schematic dialectic: "sensation is organized according to the bipolarity of light and darkness, up and down, interior and exterior, right and left, warm and cold" (ILFI, 285). Also, the mathematician and philosopher, Albert Lautman underlined across his works that it is the dialectical pairs that "dominate real physics" and "the functioning of the mind" (Lautman, 2011, p. xiv).

technical object corresponds to the symbolic reality[138] and as such responds to a half that awaits its complement, that is, to the human being himself: “In the same way, the technical being is a symbol, the half of a whole that awaits its complement, namely the human being” (PRE, 247, own translation). In other terms, it is not crucial that the machine receives the “exact” patterns from the world (an absurd fidelity) but that they recognize the relations between those patterns in the first place. This mechanism of relations between patterns *communicates a profoundly ontological and political fact at the same time:* it is possible to in-form (shape) the *archeus* of the 21st century on the basis of mathematical patterns driven by computational relations. It is the relationship between automated patterns what now weaves the cultural fabric of our century. We must put emphasis on this matter.

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[138] Simondon recalled from Plato the myth of the androgynous in the Banquet to understand the complementary character of symbolic reality.

> [...] The two symbols, which are complementary, reconstitute the primitive unity; each symbol tends towards the other symbol, it acquires meaning by reunion with its complementary. [...] A key without a lock, or a lock without a key, are not complete realities; they acquire meaning by their reunion (II, 5, own translation).

In analyzing the perceptual-motor relations between the child and the *milieu of objects,* Simondon took the example of the relationship between the toy and the child, pointing out this dialectic of the symbol:

> [T]he toy is the assistant of the self in the middle, for the best and for the worst; it forms a pair with it, as the *symbolon* with the other *symbolon*, half of the original whole whose *symbola* come by random division (II, 98, own translation).

A different type of analysis that, to some extent, aligns Simondon and Plato’s *Timaeus* is to be found in Hui (2018).

Part II

Patterns of technological evolution:

the technological axiom

A mathematician, like a painter or a poet, is a maker of patterns.

If his patterns are more permanent than theirs,

it is because they are made with ideas.

Godfrey Harold Hardy, *A Mathematician's Apology*

CHAPTER V

The technological axiom: Patterns can be computationally automated

§1. On the Rigor of Data

One of Jorge Luis Borges' most notable tales, *Del Rigor en la Ciencia* (On Rigor in Science) from 1946 described the map of an Empire which was extended point by point with such an extreme precision that the map reached the same dimensions as the territory. That immeasurable rigor aims to symbolize the importance of prudence and precision in the measurement of data. A map with the same extension as the Empire is but an anti-compressed phenomenon. Conversely to this, the more the digital data grows, the more it shall be compressed by programs and algorithms. The nature of automated processes is not based on duplicating the objects meticulously so as to occupy their same spatial dimensions, but rather, their precision lies in the *distortion of the objects* by means of compression techniques[1].

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[1] During the 20th century, the management of information complexity through probability (algorithmic complexity) served as an inspiration for what we know today as "file compression": programs that compress and decompress while saving the space used on the hard disk. One of its cornerstones is known as *algorithmic complexity theory*. The significant contribution of the Soviet mathematician, Andrey Kolmogorov (1903-1987), especially in the field of randomness probability theory and computational complexity, gave this field its name "Kolmogorov complexity". It consists in the shortest possible length of a computer program (algorithm) which returns as a value the set of, for example, digits, that make up the object. For example, the input of the following strings: *abababababababababababababababab* can be seen compressed in the following pseudocode:

```
function GenerateString1()
        return "ab" × 16
```

In this way, instead of writing "ab" sixteen times, the object is compressed with the least loss of information (lost less) which then returns the decompressed object as an output. Compression techniques, although mainly associated with file compression, played a major role in the 1980s for the inner workings (hidden layers) of machine learning models such as the autoencoder (Domingos, 2015, p. 116). Still, when dealing with reduction of complexity coming from big datasets in machine learning in general, it is a different kettle of fish. For ML cases, there is a large range of dimensionality-reduction methods such as: Principal Components Analysis, Singular Value Decomposition, Non-Negative Matrix Factorization, and many others. Cf., Garzon, et. al. (2022).

In that very tale, the art of cartography summarizes the future of the *art of data science.* Borges himself prophesied in this very tale: "the Following Generations understood that the dilated Map was *Useless* and not without Pitilessness they delivered it to the Inclemencies of the Sun and the Winters" (2017, translation by Doval with modification, own italics). As a matter of fact, the next generations understood that the large amounts of digital data were increasing at an ever faster rate and would become useless without mathematical methods able to compress and explain them, not to mention the need of computational resources to store their large volumes. The *uselessness* from that map lies in the impossibility of *generalizing*.

The following generations had to reconstruct the data by compressing it in very abstract high-dimensional spaces (also known as *hyperspaces*). The hallmark of AI-based methods, machine learning, represents the data in spaces of hundreds and thousands of dimensions not able to be captured by the human eye. In ML compression techniques[2], space can not be represented in a three-dimensional view, it is rather a deep and (sometimes) infinite mathematical representation. In a certain sense, it has not been precisely the human itself who has put an end to the rigorous task of the Empire.

[2] Following Latour, this would constitute more a *transubstantiation* rather than a reduction by occupying the place of a thing (1999, p. 64).

Figure 10. Medieval map[3] transformed by a *Deep Dream* artificial intelligence algorithm with black and white modification.

Projecting Borges' *technocartographic* metaphor, AI seems to have fully entered into this problematic territory. In principle, the *Rigor of Data* (instead of "the rigor of *science"* as the original title suggests) has succeeded in compressing, reproducing, distorting, and transforming the copy of the sum of all objects of the world together with all of their features, and all its possible future scenarios. Yet, to make the data of the world a *problem domain* for data science, one shall attempt to identify its pattern, namely, to be *classified*, *predicted*, or *clustered*. An accurate extraction of patterns equals an accurate solution (Garzon, et. al., 2022).

In general, the data not yet loaded into the computer program, are recognized as a "dataset" and the data already organized by the program (an IDE, *integrated development environment*) is referred to as the "dataframe", although the former is used interchangeably (see, figure 11). When the file (containing the unstructured data) is uploaded to the environment this one converts them into a table (dataframe) where each piece of data in the table is structured, mostly, around rows and columns. The cleaning stage following this process also involves, e.g., identifying missing values, incomplete or inaccurate data which can be achieved through advanced statistical techniques such as *Bootstrapping*. This might be the most time-

[3] Following the cartographic metaphors, when analyzing medieval maps, Seb Falk recognizes that their inaccuracy responds to an intrinsic condition already present in all maps and poses a suitable question that serves to reflect on the phenomena of compression: "Is clarity more important, or completeness? [...] Detail is not always desirable: you would not want a road atlas to be cluttered with all topological features that appear on hiking maps" (2020, p. 206).

consuming task for the data scientist, usually more time consuming than the selection of the algorithmic model to be applied to the data. Since one of the most important duties for the data sculptor (data scientist) is the cleaning and reconstruction of the data (taken from sources such as the internet and others), programming languages such as Python (one of the most commonly used for ML), for example, use a software library called *Pandas* to facilitate this task. The text file of the data, therefore, must be structured and presented, for example, in the form of tables. That is to say, files can be organized by different text editors (e.g., CSV, TXT, XLS, and others)[4].

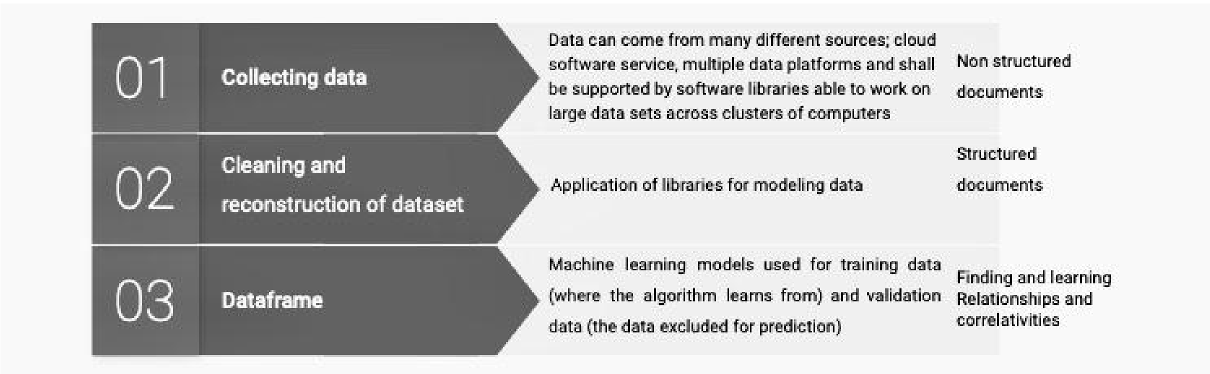

Figure 11. Basic three-step outline-summary of data analysis for ML computational methods

The extraction of patterns through large-scale data sets can be done in different ways and for different purposes (see, Figure 12). This is the nuclear task associated with the field of data science. Kelleher & Tierney elaborate on this in their introductory chapter:

> Data science encompasses a set of principles, problem definitions, algorithms, and processes for extracting non-obvious and useful patterns from large data sets. Many of the elements of data science have been developed in related fields

[4] Usually data scientists are faced with a spreadsheet whose text file can be presented in an enormous variety (csv, txt, xls, and others). That is to say, although these files are usually presented in the form of a structured table, the data is not always structured in the same way. For example, data can be grouped in a CSV, (comma separated values), in a txt, values separated by dots, as well as many others. In a further stage of the cleaning process, the dataset is loaded into an IDE (integrated development environment), and the basic information is rearranged: i.e. such as column names, missing values, blanks spaces, if we delete or infer data from that very dataset.

such as machine learning and data mining. In fact, the terms data science, machine learning, and data mining are often used interchangeably. The commonality across these disciplines is a focus on improving decision making through the analysis of data (2018, p. 1)

Pattern-type (ML methods)	Description
Customer segmentation or clustering	Patterns of customers with similar behavior and tastes
Association-rule mining	The discovery of relations between variables in order to grasp the regularities and connection between different (e.g., purchased) items
Anomaly or outlier detection	The novelty or inconsistency of some item or observation in relation to the set of data. Strange or abnormal events. For example, anomaly detection in cybersecurity or medical diagnosis
Prediction (may involve any of the previous pattern-types)	Statistical classifications for the understanding of what category or class an item or observation belongs to. A prediction to estimate future values of an item (e.g., approximate a price of a house) based on the common features of similar items (linear regression). Cluster analysis (clustering) also introduces the idea of gathering items according to their likeness with other items in the same group

Figure 12. A brief table of different types of patterns according to their uses

The cost of accurately extracting patterns is bound to the cost of the complexity of space and time in computation. The more data (bits)[5] are stored in (computer) memory, the more the level of complexity grows, and therefore, the higher the complexity of the models/algorithms able to explain them. Machine learning's evolution (and the very conception of intelligence) depends entirely on compressing/ reducing the complexity of the data (from reality) into a model (able to explain it as simply and faithfully as possible). In 1686, the pioneer of computation Gottfried Leibniz[6], already understood the problem of complexity and compression in a mathematical and metaphysical sense in his essay *Discours de métaphysique*: "in which he essentially states that a theory has to be simpler than the data it explains, otherwise it does not explain anything" (Chaitin, 2006, p. 76). In other words, the model must reduce but also combine the information in such a way that it is able to project it (e.g., like a regression curve) as simply as possible (i.e., minimize the projection error) and, finally, draw conclusions from it (i.e., formulate a prediction).

By the end of the last century and the beginning of this, disciplines bridged across applied mathematics, computational practices, and scientific disciplines have (indirectly in many cases) provided service[7] (among their various branches) on one of the most important missions for the evolution of artificial intelligence: *data compression*. "Data compression is defined as the process of encoding information using fewer bits than the original representation [...] More often than not, data is compressed in machine learning to *learn important information about data points*." (Tiu, 2020).

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[5] Data-gathering can, broadly speaking, refer to the most diverse computational properties. The digital computer is essentially bound to the notion of patterns because digital data means that "discrete elements" are able to take a pattern-form like. A few examples of data-gathering of man different types are: sequence of states (message), in message units (signals), in a collection of binary data (byte array) in structures (data structure), in attributes (database), in immutable sequences (tuples, strings), in objects (object-oriented programming), in collections of values indexed by pointers/indices (array data type), in pattern-recognition techniques (a branch of machine learning), and many others. Within this very general understanding of data-gathering, there are different levels of trades and functions, through which, the higher the level of abstraction, the more important is the role of the pattern in the data schema.

[6] Cf., Sect., Appendix, Chapter IX, §1.

[7] These areas are *not only* interrelated and bear practical fruits of their interdisciplinary approach, they also continue to cultivate each other through common shared techniques. To give just some among many examples, for the organization of complex information, the advanced mathematical tool of *tensors* (an extension of matrices) is used in applied mathematics of machine learning, as well as in various fields of physics and engineering.

Since the 1990s, when artificial intelligence shifts from a knowledge-driven approach (symbolic artificial intelligence) to a data-driven approach (machine learning), the goal has always been to ensure that while working with big datasets, the algorithms meet the specified objectives with the lowest possible cost of resources (space-time consuming). Namely, occupying the least possible memory space and executing the algorithm in the least amount of time. Compression techniques (at the hardware-infrastructure as well as the software-program level) enabled the reduction of information (without distorting it completely) into a few bits able to be processed, stored and transmitted at a greater speed.

Applied science (physics and computational: physical computing systems) has made significant contributions in distributed infrastructures to achieve a sophisticated level of information compression: they increase the transmission of large data on the network, allow greater processing power of instructions per second, integrate more functions on a chip (SoC), and reduce storage costs (unstructured data). Behind these events emerged the possibility for the very well-known phenomenon of *big data*[8]. With the emergence of big data, deep infrastructures have been increasingly taking most of the attention in the early 2000s until nowadays, *turning big data into deep data:* data observed and analyzed according to the relation of its *attributes* rather than, as the effect of predefined formulas.

Shifting the tone, beyond the general tendency to award AI achievements through improvements in the powerful hardware infrastructure (as we had even detailed in Sect., Prolegomenon, Chapter II, § 2., 2.1), nonetheless, as one of the most distinguished philosophers and scientist of the AI field, Margaret Boden, argues: "computers aren't the point of AI, most fundamentally it is about «what they do» and that has a bearing on *virtual* rather than physical machines, that is to say, with the internally information-processing system" (2016, pp. 3-4). The same is confirmed by the leading AI scientist, Stuart Russell, who argues that: "Focusing on raw computing power misses the point entirely. Speed alone won't give us AI. [...] It's not

[8] After the spread of the internet (TCP/IP model) towards the mid-1990s, the conditions for a deeper reorganization were already in place, during the same time, John Mashey, former retired chief scientist of Silicon Graphics, made use of the term "Big Data" for the very first time to refer to the handling and analysis of massive data sets (Diebold, 2012 in Kitchin, McArdle, 2016, p. 1). The reticular and extensive form of the networked technical system of the internet thanks, to a great extent, to the computational capacity of the late 1990s, gave rise to what Berry (2011) calls the "data-centric era", the chain of technical systems starting with computers towards the internet and its landing in machine learning platforms. In this regard, Domingos summarizes: "In retrospect, we can see that the progression from computers to the Internet to machine learning was inevitable: computers enable the Internet, which creates a flood of data and the problem of limitless choice; and machine learning uses the flood of data to help solve the limitless choice problem" (2015, p. 12).

hardware that is holding AI back; it's software" (2010, p. 37). The machine (at the physical level) follows the laws of physics, it is the dynamics of the information and its relations themselves that enter the field of uncertainty or what Simondon would label under the *genetic* domain:

> AI workers trying to discover what's going wrong when a program does something unexpected only rarely consider hardware faults. Usually, they're interested in the events and causal interactions in the virtual machinery, or software [...] Progress in AI requires progress in defining interesting/useful virtual machines. [...]
> For computational states are aspects of virtual machines: they can't be defined in the language of physical descriptions. But they can exist, and have causal effects, only when implemented in some underlying physical mechanism [...] (Boden, 2016, pp. 4, 5 131).

The virtual machine is fairly what runs within the physical computer, where the copy of the world, its relations and patterns become possible. Still, the data is not simply extracted, clean, processed, gathered, and analyzed, the data is looking for a pattern, a worldview that explains them. The convergence of the human-machines views may not lie in the prosthetic (transhumanist thesis), not beyond subjectivity (posthuman thesis), the real convergence might imply a dynamic interaction of the abstract models of the world where patterns are seized between the mind and the physical realm. The human cognitive schema was never so close to *its own patterns* as it is in our days. "Humans have always abstracted from the world and tried to understand it by identifying patterns in their experiences of it. Data science is the latest incarnation of this pattern-seeking behavior" (Kelleher & Tierney, 2018, p. 236).

1.1. The problem of methodological unity in machine learning: An introduction to the concept of *model*

In the formal mathematical nomenclature a *model*[9] implies the transformation of axioms into truths (i.e., theorems) and its structure is described according to objects of reference (applied mathematics) or beyond any possible object of the world (pure mathematics)[10]. That very process of transformation implies the complex idea of generalization[11]. The roots of this study has its greatest scientific precision within the hypothetical-deductive models based on the deductive structure for the satisfactory establishment of laws.

Different from deductive systems, and particularly when referring to inductive systems (a model derived from a body of observations) many epistemological studies had been unsatisfactory driven to obtain laws or models in the field of human behavior. Although diverse empirical practices in the field of cultural studies did have broader scope through the use of inductive methodological tools, these practices were considered by many as pseudoscientific (Willer and Willer, 1973) and still, have been further developed through computational methods (Pool, 1959, North et al., 1963, Stone et al., 1966, Holsti, 1969, Gerbner et al., 1969). In, *Decoding culture*, Tudor extends that such methods have the following goal:

> The goal of establishing direct correlations among variables at the expense of understanding the social and psychological mechanisms which generate the correlation. In the limiting case this leads to a behaviorist focus on stimulus-response associations, and even in less restrictive conceptions it leads to a

[9] Etymologically the Italian word *modello* or, in French, *modèle* belongs to the Renaissance period (16th century) and it was derived as the diminutive of the Latin word "*modus*" meaning the manner, the method, the measure. A century later this concept acquired the status of that which conforms to a pattern, as that archetypal figure worthy of imitation, and around the 1690s the concept was transferred to the human image that serves to be recorded (painted, sculpted) thus allowing further mechanical reproduction.

[10] This is extended again in Sect., Appendix., and in a paper I authored called: "The correspondence theory of mathematical objects: on automatism and intersubjectivity" (2021).

[11] According to Albert Lautman, mathematicians like Frechet or Bouligand made an effort to bring together the axiomatic abstraction to the idea of generalization, from which he concludes that: "Generalization is however, with them too, only the consequence of more essential preoccupations", these essential preoccupations where, in fact, for Lautman, of a platonic type (Lautman, 2011 [c. 1937], p.42). Also see., Bouligand, G. (1935).

tendency to express «findings» as superficial associative statements (1999, p. 28).

Just as in scientific research, correlation eliminates causation between the variables under scope, in cultural studies, correlation completely overlooks the particular psychosocial traits behind behavior and customs. Now, when referring to predictive models from computational schemes such as those of machine learning we are far from the perfect mathematical-logical architecture of any formal system of proof [12] (whose deductive methods had been taken into account in its early days of symbolic AI). Rather, with machine learning models, a much more impure sense of mathematics as that of formal number theory, a much more complex dynamic and a much imprecise relationship with the world is to be applied. Why do we assume it as impure? Not because machine learning refers to applied mathematics but because it falls under an estimated, useful, opaque, and intuitive approach to mathematics in computation as different from its exact, logical, transparent, and formal foundations.

> In its simplest form, a mathematical model is an equation that describes how one or more input variables are related to an output variable. In this form a mathematical model is the same as a function: a mapping from inputs to outputs. In any discussion relating to models, it is important to remember the statement by George Box that all models are wrong but some are useful. For a model to be useful it must have a correspondence with the real world. This correspondence is most obvious in terms of the meaning that can be associated with a variable. (Kelleher, 2019, p. 40)

What does a variable mean in the ML context? It is an attribute of a quantifiable nature, that is to say, not an isolated number (which has no correspondence with the world) but a number in correspondence with something from the world, for example, the income of a particular person would be an attribute. A variable or attribute can be defined as follows: "Each instance in a data set is described by a number of attributes (also known as features or variables). An attribute captures one piece of information relating to an instance. An attribute can be either raw or derived" (Kelleher & Tierney, 2018, p. 239), we will come to the last differentiation

[12] For example, for describing sentences with number theory, Douglas Hofstadter in his famous book "Gödel, Escher, Bach" (1979) developed a Typographical Number Theory (TNT), which is, a formal axiomatic system together with a Peano arithmetic implementation. On the latter, Cf., Sect., Appendix, Chapter IX, §1.

later. In more simple terms, features, attributes or variables are those essential quantifiable properties that define the object and, when applicable, its behavior as well. Following these essential distinctions, culture, whose nature is defined by patterns designed by human sense, *in principle*, would not be of a quantifiable nature. This is precisely what is being hacked from its very source and what we aim to elaborate further in the third axiom (Sect. Part III).

While formal deductive systems require *determination*, statistical inductive systems require *estimation*. The dynamics of the latter becomes clear enough when grasping the proliferation and transformation of machine learning methods every year, which in turn, requires the continual update of software packages and libraries. In machine learning, usually, the mathematical tools to rearrange the data are not manually applied (since it would be very inefficient, particularly because of, the already explained, time-consuming costs to achieve it together with a higher human imprecision). It is, rather, implemented through mathematical *libraries* (e.g. in Python language: NumPy) able to operate with very large datasets. These practices turn the field into a vast amount of inter-related technics, into a real *Babelic*[13] where any attempt to reach a unifying foundational framework seems highly difficult to conceive.

[13] This is a reference to Jorge Luis Borges' short story: *The Library of Babel* (1941) which consists of a library organized in hexagonal rooms that can be read as the whole universe with all its possible combinations. This library requires the search for the algorithm to be found one day, this very algorithm implies the index of the library contents able to organize the whole library, namely, the whole universe.

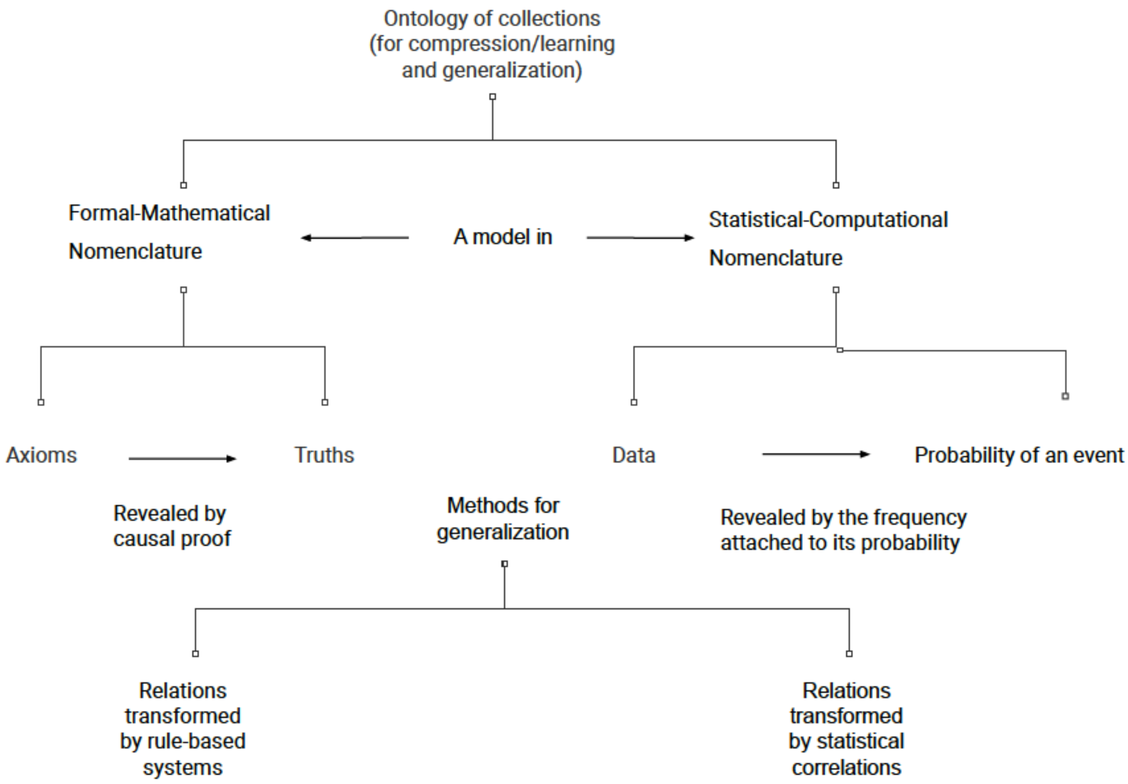

Figure 13. Overall view of concept of *model* from two different representational approaches

The concept of model within the computational and statistical field, in turn, requires another distinction. Margaret Boden, underlines the difference between the *conceptual* meaning of the model as expression of computational theory, on the one hand, and its *implementation* as simplification of that theoretical model, on the other (2016, p. 123). As a theoretical or conceptual expression, models are related to what Albert Lautman called "structural schemes", which, at a great scale, resembled precisely the very platonic *εἶδος* (eidos). In this sense, the conceptual model is a mathematical expression or a mathematical form that transcends data within their particular contexts. That means that it abstracts and represents (with greater or lesser fidelity) some state of the world. When referring to the implementation, there is another fundamental observation:

> [J]ust because the computer identifies a pattern in the data this doesn't mean that it is identifying a real insight in the processes we are trying to analyze; the

> pattern may simply be based on the biases in our data design and capture (Kelleher & Tierney, 2018, p. 48).

A pattern does not immediately express an underlying or self-evident reality; it requires the correct treatment of data and the algorithm that, by fitting the data, has the lowest level of bias. Only after its implementation, the quality of a model can be measured (for example, in machine learning, one of its possibilities is through the calculation of MAE, *mean absolute error*) which always differs, as already expressed, according to the type of data and its context.

When referring to the implementation of a model, other conceptual distinctions take place. Although the terms "models" and "algorithm" in machine learning are often used interchangeably, they do not have the same meaning. Machine learning *algorithms* are methods or procedures (e.g., for classifying, estimating, or clustering data) provided from a library, which, when implemented in code and run on data, *generate a model.* In other words, "[m]achine learning provides a set of algorithms that generate models from a large dataset" (Kelleher & Tierney, 2018, p. 149). In this case, the model is the final program: the architecture, its structure, rules, values, and learning output. For example, an optimization algorithm, such as the well-known *gradient descent,* optimizes the parameters of the data to create the model (architecture and weights). Which model? A model that better explains and predicts the new/ unknown data. The authors, Kelleher and Tierney, explain how the influential Leo Breiman distinguished in his paper "Statistical Modeling: The Two Cultures" (2001) between the *statistical models* as those *explaining* the data and the *algorithmic models* as those *predicting* rather than explaining the data accurately. This difference constitutes a "core difference between statisticians and ML researchers" (2018, p. 18). When referring to machine learning's main theory, Alpaydin resumes it in the following manner:

> The main theory underlying machine learning comes from statistics, where going from particular observations, called the *sample*[14], to general descriptions

[14] Also, in order to differentiate both cultures, it is important to highlight that for big data, machine learning, and predictive analytics, they do not refer to *sample* in the traditional sense, in his book, *Big Data*, Schmarzo explains:

> You don't necessarily have to apply statistical techniques to these massive data sets to understand why certain behaviors occur or why certain things happen because you are not dealing with samples, but instead are dealing with the complete population of data (2013, pp. 53-54).

of the population, is called *inference* and learning is called *estimation* (2021, p. 32).

The difficulty to conceive a unified view of the field of machine learning derives from the dynamic, interest, and extent of a large interconnected community with different practices, subdivided tasks, interdisciplinary scientific bridges, and the non-linearity of the data science practices for solving a problem[15]. Despite this fact, mathematicians, scientists, and computer specialist who study automated learning algorithms to the light of formal mathematical problems[16] do conceive common aspects of machine learning in order to pursue a unified theory:

> Machine learning deals with various kinds of statistical problems, such as pattern recognition, regression and clustering. These problems share important properties in common. Perhaps the most basic similarity is in their goal, which can be roughly stated as: Approximate a target concept given a bounded amount of data about it.
> Another similarity lies in the ideas and techniques that are used to study them. One example is the notion of generalization, which quantifies the quality of the approximation of the target concept. Other notable examples include algorithmic principles such as ensemble methods, which combine multiple algorithms in ways that improve on their individual performances, and optimization techniques such as gradient descent.
> The affinity between these learning contexts leads to a pursuit of a unified theory. (Ben-David, et. al., 2019, p. 44).

Behind these common characteristics, around their diverse objectives, applications and their methods there is, in turn, a creative search for solutions to mathematical problems that

[15] See the CRISP-DM model (business understanding, data understanding, preparation, modeling, evaluation, and deployment) to understand how data processes have no linear fashion, differently, they can dynamically move from one stage to another and back. Cf., Chapman, et. al. 1999.

[16] These are formalizations left specially by Cantor and Gödel (Sect., Appendix, Chapter IX, §2.), this implies, very briefly expressed, an understanding of machine learning practices (learnability-simplification), i.e., how well a model adjust to its weights, under mathematical formal theory (generalization-compression).

involves the crosslinking between the domains of arithmetic and algebra and the association of their methods. That means that the difference between machine learning methods does not always imply differences of domain and shall not only be seen as multiplying and dividing the paths. “The method is the idea of the idea” (HNI, 465) evoked Simondon in recalling Spinoza, that is to say, the method corresponds to that measure that allows the intellect to acquire knowledge before achieving any unity. Again, following the platonic mathematician Albert Lautman: “it is in this encounter of methods that gives rise to the profound unity of mathematics” (2011, [c. 1938], p. 59).

The efforts to relate methods are particularly characteristic of twentieth century mathematics related to interdisciplinary scientific research. According to Lautman (1938) such efforts do not only reveal the particular properties of the entity within a set but also expose the membership of a set and its overall structure. That is to say, mathematical entities can be applied in both ways: to analyze individual properties as well as to analyze the relationships that give structure to these properties according to a «common plan» which, in this context, implies “learning”.

The recognition of patterns, for the learning process to occur in the very first place, is driven by the conversion from “the raw data (such as the pixel values of an image) into a suitable internal representation or feature vector” (LeCun, Bengio, and Hinton (2015, p. 436)). As the pioneers of deep learning methods explain[17] (a subfield within ML), machine learning for many decades required of considerable domain expertise and engineering for the feature extraction process, but the difference now, through deep learning, is the many levels of representations automatically discovered by the learning system itself: “The key aspect of deep learning is that these layers of features are not designed by human engineers: they are learned from data using a general-purpose learning procedure” (p. 436). In other words, deep learning can learn useful features for very large datasets and offer, in turn, highly accurate mathematical models (Kelleher, 2019, p. 35). We will extend later on what a feature or a vector implies in this context.

The kernel of machine learning is recognizing patterns, that is, sorting out the features of data into identifiable classes, groups or clusters. The process of sorting out data represents learning. Learning implies transcending the properties of data and finding relations and structures between them in order to express a future prediction or a future state of the world. Technically, this process is what is meant by data mining (one of the methods of machine

[17] One of the most relevant papers from the field of machine/ deep learning had been published in *Communications of the ACM* journal by their three most important pioneers. Cf., Bengio, Y., Lecun, Y., Hinton G., (2021).

learning): "in data mining, a large volume of data is processed to construct a simple model with valuable use, for example, one with high predictive accuracy" (Alpaydin, 2021, p. 14). To find structures implies to find a model (a mathematical model) that properly fits the data at stake. According to the father of deep neural networks, Geoffrey Hinton (1987), it is precisely the learning performance that can guide evolution[18] in its widest sense.

Mathematical automation or machine learning, in this context, corresponds to how a mathematical model explains the data not as axiomatically true, but, more or less statistically correct. The use of the term "automated" highlights the role of the algorithm in manipulating the values and mathematical variables at stake while implying *technical human intervention* in any of its three well-known types of machine learning practices: supervised, unsupervised[19], and reinforcement learning. In all three cases, the generalized and approximate way of explaining the data requires constant readjustment of a mathematical function (learning) by the algorithm according to the calculated percentage of error.

What has been translated as "learning" in relation to *machine learning* can be roughly described as "finding" a mathematical function (a model) in order to "make sense", i.e., to identify, relate, rank, classify, and predict patterns from large datasets. With the flow of ever-increasing data, it is difficult to achieve "learning" in terms of logical steps derived by formal deductive rules towards «knowledge» but it rather matches and correlates data derived by induction towards «awareness» of the patterns at play: "Machine learning is the *art and science of finding patterns given some data*. These patterns are then used to make predictions on important outcomes or shed light on the relationships underlying the observed data" (Kumar, 2020).

Well-known cases of machine learning models ranging from linear regression, decision trees, support vector machines, artificial neural networks, k-Nearest Neighbors, to name some

[18] In its specific context, the field of neuroscience and biology, James Baldwin proposed the eponymous in "A new factor in evolution" (American Naturalist, 1896), also known as "the Baldwin effect". Geoffrey Hinton and Steven Nowlan implement Baldwin's as well as Morgan's idea in their article: "How learning can guide evolution" (1987). The aim of their contribution is to demonstrate that the claim of most biologists, that learning does not guide evolution, is an incorrect assertion. To this end, the authors propose the study of how neural interactions do not produce better connections and results in a random fashion, but rather, there is a balance between the specifications made by the genotype (about how to carry out the connections) and the discovery of decisions (about how to carry out a good connection) inherent to the very learning process (1987, p. 496).

[19] There is also the semi-supervised category. For example, generative adversarial networks (GAN), where two models (generative-discriminative) are trained simultaneously, contain unsupervised as well as supervised processes. Cf., Goodfellow, et. al., 2014.

of the most well-known, are all trained to recognize and predict certain patterns when new data is inputted[20]. Nonetheless, with different algorithms, *patterns are recognized in several different ways and they are of a different nature*. In terms of a mathematical expression, these patterns are the result of using equations of different types: linear algebra, calculus, statistics, multivariable calculus, differential equations, among many others (see later, figure 15). For example, calculus is used for gradient descent (which, as pointed out, is an optimization algorithm), linear algebra for matrix operation (which holds the values of the analyzed items) and statistics for understanding models (which is the representation learned by the algorithm).

The relations between our models of reality (those patterns that can be of help to *make sense* and *organize* reality) are not without mutual contradiction and can even be generally understood under what we label as "intelligence"[21] [22]. From a general philosophical point of

[20] It is important to mention that visualizing data in terms of patterns through a graph is more eye-catching and revealing for the human eye than using spreadsheets but the pattern is to be found equally in both.

[21] The contemporary AI German researcher, Josha Bach, expressed in an interview:

> Intelligence is the ability to model, it's not necessarily goal directed rationality [...] but it's the ability to be presented with a number of patterns and see a structure in those patterns and be able to predict the next set of patterns. To make sense of things. And some problems are very general. Usually intelligence serves control so you make these models for a particular purpose of interacting as an agent with the world and getting certain results [...] the intelligence itself is in a sense instrumental to something but, by itself, it's just the ability to make models. (Bach, 2020, 25:00-25:35).

This functional or algorithmic description of intelligence in terms of *the ability to generate models* of reality is particularly enriching since it implies a reality that, initially, resists to be identified with instrumentality. Precisely, the model is a structuring agent, capable of conferring unity through the dynamic relation of properties rather than as a result of their assembly. Following this thread on the definition of intelligence as the ability to model, it becomes possible to derive the assumption that what structures our interaction with the world depends on *the models we have been provided with* or those created for our own purposes. In other terms, how we were in-formed and how we *in-form* (in the simondonian sense), how we *model* reality largely depends on the pre-existing as well as expected patterns. We will come back to this very crucial point when analyzing the concept of pattern in cultural and political terms (Sect., Part III).

[22] *Intelligence* as a feature for modeling the environment (*die Gestaltung der Umwelt*) can constitute a non-teleological perspective of the field. However, taking into account and subscribing to Floridi's et al. (2016) view, it is important to notice that addressing the ethics of algorithms independently of its software implementation makes little sense because the algorithm is *configured* for a specific case or problem (p. 2). The conundrum of intelligence as the discovery of harmonic patterns and thus of a certain "structure in the space of possible solutions" (Bostrom, 2014, p. 180) remains as an opening resource of contemporary debate in

view, we can say that the model is located as a hinge between the «existent» and the «possible». It represents some aspect of reality and, at the same time, it expresses a possible state of things. In philosophy, whenever the existent and the possible are correlated, the problem of the *transcendental*[23] emerges. This mirrors the metaphysical and technological visions: the *techno-sphaeritas*, as seminally found in; Llull, Pascal, Leibniz (Sect., Appendix, Chapter X, II, §1, see figures 21, 22, 23). It is no coincidence that from the notions of model and collective memory, new concepts of a *transcendental* type have arisen from those who not merely explain and describe machine learning but also look forward its implementation: "One Machine" (Kevin Kelly) "Overmind" (Georg Dyson), "Master algorithm" (Pedro Domingos), "Superintelligence" (Nick Bostrom), "Superhuman cognition" (Elon Musk), "Mind fire" (Hans Moravec), and others[24].

When referring to the combination of models according to the common plan for the "learning" performance, machine learning researchers, scientists, and AI philosophers can be divided and classified between those who follow[25] Leibniz's[26] credo and those who do not. The former assumption aims for the unity of the field. This proceeds not by using the same methods (in fact, they combine different and sometimes transdisciplinary methods) but by the belief of achieving some unifying model of cognition. In our century, the former group[27] generally considers that the evolution of machine learning can eventually converge into a scalable model (although all of them holding, as already underlined, different approaches): (Yann LeCun, Yoshua Bengio & Geoffrey Hinton (2015), Pedro Domingos (2015), Ben Vigoda (2016), Ray

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which most of the narrow algorithmic systems of goal-based analysis are subdue to. A broader general purpose learner is not a speculative or disputed school of thought solely linked to AGI (artificial general intelligence), conversely, it percolates the whole nature of the field behind its main understanding of intelligence which remains as the most debated and disputed concept of our times.

[23] The concept of the *transcendental* in philosophy can be regarded, at least, as of three different types: i) God who creates (theism), ii) the transcendental subject who (by his mind's inner modes of processing sensory information) creates subjective experiences (transcendental idealism) iii) the logic of predicates where all rational statements can take place (first order logic).

[24] Cf., Warwick, K.(1997). Also see, Geraci, R., (2010).

[25] In the 20th century the first group was followed by Boole, Frege, Cantor, Hilbert, Gödel, and Turing through the logical-mathematical and later, computational bases.

[26] Sect., Appendix, Chapter IX, §1.

[27] At present, this group employs diverse and different methods of integration of both mathematical and computational properties in consideration of methods coming from other disciplines, the development of infrastructures and hardware, and together with it, the growing environment of data.

Kurzweil (1999, 2005, 2012, 2022), and others). On the other side, as skeptical to the former, can be found the arguments for the divergences and multiplicity of methods and specific use-cases without ever achieving ultimate models of intelligence: "Leibniz's credo need not be followed. Controversies cannot be conclusively computed. Machine learning is not the ultimate form of intelligence" (Pasquinelli & Joler, 2020, p. 2).

The perceptual studies in artificial neural networks led by leading experts such as Geoffrey Hinton, Yoshua Bengio and Yann LeCun, and the Google Brain research team (Chollet & Allair, 2018) worked in 2010 in the largest artificial neural networks (ANNs) for machine learning (Yann LeCun, 2012). By 2021 the largest ANNs became and continues to be the generative language model GPT-3. Since 2010, every new ML approach dealing with large amounts of data (Big Data) has been proclaimed as a completely disruptive event not only for the field of artificial intelligence but for society as a whole. Still, it shall not be overlooked the fact that, for example, "deep convolutional networks existed, with all mathematics fully worked out, more than twenty years before they began to create headlines" (Russell, 2020, p. 63).

For some researchers in the very field of humanities, ML was considered as *vita nova* (Sect. Part III, Chapter IX, § 1.), while for others, the "techno-skeptics" as called by Max Tegmark (2017), machine learning still remains just as another tool for data-driven implementations not worth to be granted with grand narratives. Waters divide. Examples of the former are the opening spirit of research in digital and media studies such as those of Roberge and Castelle: "ML has developed a cultural life of its own" (2021, p. 7)[28] while, as examples of the latter case in the same domain, can be found in Adrian Mackenzie interestingly claim: "Machine learning is an accumulation rather than a radical transformation" (2017, p. 5).

As we will extend in the next section, most of the mathematics applied in machine learning existed long before computers did, the disruptive factor does not precisely lie in the radical transformation but in its potentiality to combine and establish innovative relations using, to the surprise of some observers, many simple calculations. All of the mathematical functions of machine learning, implying their different modes of mapping from inputs to outputs domains,

[28] Machine learning today, as cybernetics before, awakens conferences, seminars, forums, research centers, and reactivate private and governmental funds. Like cybernetics or as a corollary of it, the interdisciplinary field, according to Simondon (when referring to cybernetics): "designates and defines a collective intellectual consciousness" (EC, 190, own translation). Simondon envisioned in cybernetics, bringing together specialists from various fields "engineers, electronics specialists, psychiatrists, neurophysiologists, and finally, mathematicians such as Norbert Wiener himself" (EC, 189, own translation), the interdisciplinary spectrum that we see even increased today with the field of machine learning and its derived subfields.

as John Kelleher summarizes, are not distinguished by "the complexity of the math [they are] built on, but rather, that [they] can perform such a diverse set of exciting and impressive tasks using simple calculations" (2019, p. x, with modification between brackets). It should be noted, by the way, that there is a considerable amount of mathematical complexity, but that is precisely where we do not really come close to if not through the already mentioned *mathematical libraries.* Today the programmer no longer knows much of the algorithm or even touches much of the code, but rather, has to adapt it and know how to use its libraries. In a certain sense, the programmer has become an "organizer of algorithms", close to what Simondon understood under the concept of "mechanologist": the human being (*technologist*) mediating between machines and introducing their nature into culture (Barthélémy, 2012, p. 229). Machine learning, as a collaborative, dynamic, and interdisciplinary practice, might not be regarded as mere accumulation but as the expression of technological potentiality. It is much less an Aristotelian entity (individual is an accumulation of categories) than Spinozian practice (individual is a relation driven by potentiality). It is *a point of emergence in the process of conserving or arising patterns that model, shape, and integrate the growing pattern-based view of reality.*

§2. The mathematics behind the pattern

One of the most important elements to understand the role of mathematics in ML, and therefore of patterns, is to understand the notion of space. With this aim, we shall underline an important distinction about the concept. From a two-dimensional view (such as a map), space implies *spatial distances* between observable objects, however, in the context of machine learning, where big datasets can not be perceived by the human eye, *the space is not primarily based on the distance but on the concept of affinity*.

This can be exemplified in the application of *dimensionality reduction algorithms*. With big data, dimensionality reduction is required. Otherwise, faced with large amounts of inputs, the dimensions begin to multiply and pattern detection becomes extremely complex for the algorithm. This is well known in the field as "the curse of dimensionality" (Bellman, 1961). For example, a physical map compresses in two dimensions the three dimensions of a particular geographic spatial distribution, in the same sense, dimensionality reduction algorithms also compress a number of higher dimensions into a smaller amount: if the algorithm is able to work with up to 50 dimensions and we have 200, the remaining 150 are projected in those 50 dimensions.

According to their grade of affinity, the distributed data in space, tend to cluster together, that is, “points that are *«similar»* are closer together on the graph” (Tiu, 2020). For data analytics, the goal is generally to visualize data points that share a combination of attributes (Almudena, 2019).

> In other words, the model *learns* the data features and simplifies its representation [...]. This is at the core of a concept called *Representation Learning*, defined as a set of techniques that allow a system to discover the *representations* needed for *feature detection* or *classification* from *raw data* (Tiu, 2020, bold modified by italics type).

Similarity or affinity (data points closer to each other within a coordinate axis, see figure 14) implies that objects tend to have specific resemblances in their attributes.

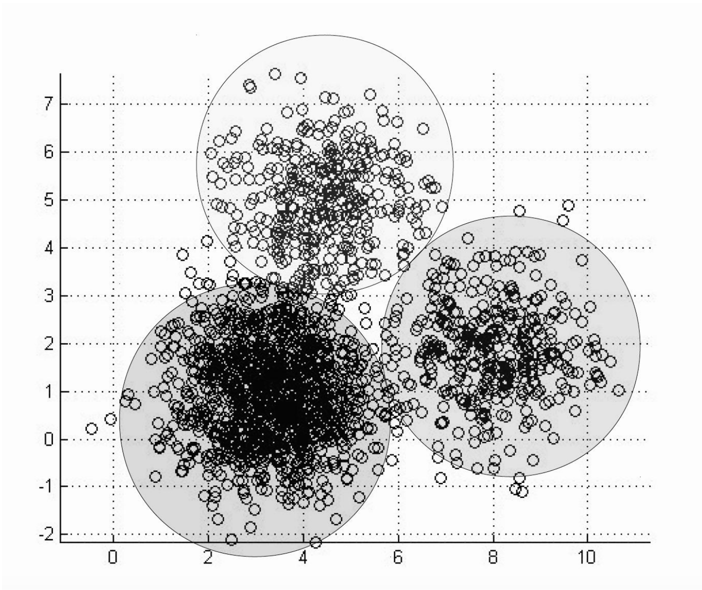

Figure 14. Example of a formed cluster based on the affinity of data

These resemblances or affinity can also lead to absurdity: an advanced algorithm can mistake one object for another (e.g., identify a dog as a flower). This is due to the essential aspect of ML technology: it lies in the *relationship between the attributes* and not substantially in the attributes or objects themselves. In order to reduce dimensions and enhance the learning phase, some less-essential attributes shall be avoided. If considering that a ML algorithm learns to recognize abstract universals (objective function, loss function, or cost function), for example the recognition of a *hand*, what is taken in consideration are the distinguished attributes learned by the model (e.g., patterns of its angles and finger shapes) while, perhaps, leaving aside some other distinguishing features (e.g., color of the hand). Such a decision can help to optimize the reduction of complexity of the space. Therefore, learning in this context means generalizing by induction. Bachelard, although focused in microphysics, recognized this occurrence in 1984 as proper to the scientific spirit: "true scientific thought is metaphysically inductive; as we shall see repeatedly, it reads the complex in the simple, states the law that covers the fact, the rule that applies to the example" (p. 6), and we shall further include: the algorithmic model that explains the data.

Pattern recognition in machine learning consists mostly of three well-known mathematical methods: classification and regression analysis (both are supervised methods), and clustering (unsupervised method[29]). Classification can be regarded as discriminant analysis in statistics or pattern recognition by engineering (Alpaydin, 2021, p. 32). As its name indicates, classification implies designating the value of an input within a corresponding class or category, this technique is known as "labeling", for example, labeling an adult/child according to their

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[29] From the already mentioned branches of machine learning: supervised, unsupervised, and reinforcement learning, each has a specific use-case for what it better performs, i.e., there is no "best algorithm of all" or a "do-it-all machine" (this is known as, "no free lunch" (NFL) theorem) but different algorithms that perform better according to the specified task. No technical object or applied method is better nor *plus vrai* than another but more *appropriate* to correctly perform certain functions (PIT, 231). Nonetheless, we can address the fact that in machine learning, unsupervised learning is the method that can work more efficiently with larger amounts of data (e.g., unclassified data), although most ML in use today belongs to supervised learning. In an interview with the *MIT Technology Review*, Yann LeCun, Chief AI Scientist at *Meta*, winner of the Turing Award (2018) and one of the most important references in machine learning stated that the future of AI is unsupervised (Hao, 2019). For LeCun, the importance of self supervised learning (SSL), which he identifies as "the dark matter of intelligence", also falls within this branch (LeCun, 2021). An example of unsupervised learning is the distribution of customer profiles which can be carried out through techniques such as clustering, for example, the so-called "customer segmentation", pointed out at the upper level of figure 12 which allows to group customers with similar attributes (Alpaydin, 2021, p. 144).

weight and height. At the same time, classification can be identified in terms of simple algorithms (logistic regression, decision lists) or more complex algorithms (deep neural networks, boosted decision trees, random forests) (Rudin, 2019, p. 207). Differently, regression consists of the identification of patterns according to the relationships of the most fundamental variables to understand the trend of a data set, for example, to identify the price pattern of a house in a specific city and neighborhood it is necessary to identify which variables allow inferring the price of similar houses. Finally, the grouping method (such as clustering) partitions the data into groups when no categories/classes are available, such as the case of grouping genes and proteins with similar functionality.

Before the creation of computers, the underlying applied mathematics of machine learning had already been elaborated long ago: approximation of functions, approximation and sampling of probabilistic distributions, solving differential equations, and many others. The automation of mathematics involves, for example, as pointed out by the Director of Beijing Institute of Big Data Research, Weinan, E. (2022), the integration of combined equations for generating *photos of the human face* by approximating a probabilistic distribution, achieving the optimal *Go game strategy* by solving the Bellman equation in dynamic programming, we could further add, speech recognition by using an integration of Boltzmann equations, and many others. Some of these belong to cases of numerical analysis that have been in use for more than two thousand years (for example, with linear interpolation). Therefore, a question stands out: what's actually innovative with the mathematics of machine learning? Precisely, what we described since the beginning of this chapter: *dimensionality reduction*. As Weinan (2022) points out, what the underlying mathematics of machine learning does is to reduce the dimensions so that the computational cost does not grow exponentially[30]. By pointing out to the relation between layers of a convolutional neural network, Alpaydin explains the need for dimensionality reduction in the feature extraction process, that is, in the creation of the pattern:

> Feature extraction also implements dimensionality reduction because although the raw attributes that we observe may be many in number, the important hidden

[30] Many different technics, as we already wrote, help to reduce the dimensions in hyperspace, Kelleher & Tierney offer one of many examples: "A recent development is the t-distributed stochastic neighbor embedding (t-SNE) algorithm, which is a useful technique for reducing high-dimensional data down to two or three dimensions, thereby facilitating the visualization of those data" (2018, p. 13). This is also found in: (Tiu, 2020).

features that we extract from data and that we use to calculate the output are generally much fewer (2021, p. 125).

This is true for any algorithm, however, machine (deep) learning techniques can deal at an unprecedented level with a large number of dimensions.

Mathematical tools in Machine Learning	
Linear algebra	Systems of equations, vectors and vector spaces, scalar and vector products, *matrices* (most-used), and linear applications, determinants and traces, tensors, norms, eigenvectors and eigenvalues, analytic geometry: lines, planes, and others.
Analysis	Functions, types of functions, graphs of functions, limits, derivatives (most-used), gradients, maximums and minimums, integrals, and error computation.
Probability and statistics	Probability (dependence and independence, conditional probability, Bayesian networks), statistics (mean, variance, and deviation, distributions, covariance, correlation) and information theory.
Other mathematical tools	Combinatorics (variations, permutations, factorials, binomials), graph theory, algorithms, treatability, asymptotic complexity, and logic.

Figure 15. List of the mathematical tools required for implementing machine learning

One of the classic introductory examples to the practice of machine learning is to predict the cost of a house, an example that allows a quick visualization of the object (e.g., house) and its attributes (room numbers, length, color of walls, etc.). In this case, three columns (the already mentioned attributes) containing three numeric values would equal three dimensions. The learning process therefore implies that the algorithm will have to adjust its model according to these three-dimensional coordinates. But when dealing with large, multidimensional data sets, an object, also known as datapoint or a node (e.g., a customer) with many attributes (web-sites cookies, demographic information, billing and transaction records, phone usage, clicks on online platforms, social networking, installed apps, social media posts, the attention measured by time in any post, and many others) implies many attributes with missing values, complex and dynamic relationships, it also implies much higher dimensions: "[...] data science is often applied in context where we want to look for patterns among tens, hundreds, thousands, and, in extreme cases, millions of attributes" (Kelleher & Tierney, 2018, p. 4). Simply expressed, more attributes equals to more space. Reducing the space, therefore, implies reducing the attributes that are not relevant to the stated purpose. Already from the very origins of cybernetics Wiener expressed: "To live effectively is to live with adequate information" (1989, p. 18). Based on the adequate information, the algorithm must fit its model according to coordinates of hundreds of thousands of dimensions. According to how the algorithm is adjusted, a percentage of error is obtained, and upon this result, the algorithm is able to improve and optimize its learning rate.

The attributes (the columns in the table of a dataset) can be chosen manually and intuitively (by the intuition of the human agent) or they can be derived automatically (by the calculations made by the mathematical library of choice). The first case is recognized as supervised learning where the attributes of the objects are designated/labeled manually. The second case is recognized as unsupervised learning where the attributes are recognized automatically because they also share common patterns[31]. The biggest difference between supervised and unsupervised learning is that the data of the former is "labeled", that is, with informative concepts, for example, a piece of data can be labeled with the word "fish". As we mentioned before, there is a third type of learning, reinforcement learning[32], mainly applied in robotics, which works by trial/error testing, positively reinforcing the correct results while discouraging incorrect results within an uncertain environment.

There are many ways in which these attributes can be related. Few attributes can lead to a loss of information, namely, the model fitting fewer attributes than required cannot capture differences and relevant patterns, and conversely, a large number of attributes can lead to a lot of noise (called adversarial noise) along with loss of accuracy due to the possibility of infinite combinations. The first case is often referred to as "underfitting" (too simple and general, too many objects share such attributes). The second case is designated as "overfitting" (too complex and specific, works well in the training set but not in the test set and it cannot capture much of the new inputted data because the algorithm has learned from too much noise). Inferring objects

[31] On the foundations of supervised and unsupervised learning, Cf., Jo, T. (2021).

[32] Cf., Sutton, R. S., & Barto, A. (2018) for a clear and precise introduction on reinforcement learning.

from attributes (e.g., visual recognition tasks) can lead to problems of both epistemological and ethical nature (e.g., as has already occurred, confusing asian eyes with being asleep, among many other examples). When completely different objects (such as, for example, a dog and a flower) share many *semantic properties*, i.e., structural similarities shared between certain attributes (in this case, fuzzy white lines), an algorithm with high bias fails by recognizing one as the other. This flaw is known as *adversarial examples* (Szegedy, et. al., 2013). What is interesting behind this is the importance of the space behind research conclusions: "It suggests that it is the *space*, rather than the individual units, that contains of the semantic information in the high layers of neural networks" (Szegedy, et. al., 2013, p. 1, own italics).

Returning to the importance of space, there are several mathematical techniques to deal with dimensionality reduction[33]. Even so, the advanced mathematical functions used to understand this affinity between data correspond largely to the branch of *linear algebra* that relates precisely to *matrices*. Each row is an object of the array and each column is an attribute of the array in question. From the matrices we obtain the vectors that indicate how the data are distributed (for example using one of the oldest and widely used dimensionality reduction algorithm known as PCA: principal component analysis), according to their direction (*eigenvector*) and their length (*eigenvalue*)[34]. Alpaydin (2021) explains: "In mathematics, we model data using matrices, which is why this approach is called *matrix decomposition*, or sometimes *tensor* decomposition, tensors being matrices with more than two dimensions" (p. 154).

For the distinction of more complex data, not only reserved to certain measurable physical objects *but also* to vast amounts of data proceeding from molecular biology and chemical processes as well as from classifying large surveys of new objects (astrophysics), and all types of human decisions, *another spatial representation is required*. In machine learning, space arises from the attributes of the objects and the data is defined in space according to its

[33] E.g., the linear models; Principal Component Analysis (PCA), Linear Discriminant Analysis, Factor analysis, and the non-linear ones: diffusion maps, multidimensional scaling, Sammon's mapping, and others. Cf., Garzon, et. al. (2022).

[34] By contrast, algebraic operations that distinguish data according to the spatial distance can be, for example, scalar product (also known as dot product) or Euclidean distance. However, it is important to remember that in machine learning, in supervised learning (algorithms like k-nearest neighbors) or unsupervised learning (algorithms like k-means clustering), the calculation of Euclidean distance is used to measure the distance between training and test data also plays an important role. Cf., Brownlee, 2020.

attributes. As we emphasized already, the reduction of dimensions allows the algorithmic model to generalize better.

Why does space occupy such a crucial role in our hyperhistorical phase? As we wrote previously, it is no longer enough to understand the world encompassed by technologies[35], it is necessary to see the world *spatialized* by the technologies themselves. The notion of space is not regarded here as the (*extensum*) of traceable elements (*corpus physicum*) within a specific environment, instead, space is understood in the sense of an *ontological collection*[36] of attributes whose rearrangement implies a unity of form (a resulting pattern). In other words, space is what gives us context (*sense*). Throughout their extensive literature, so much von Uexküll, like Heidegger[37], and Simondon resonate with this idea. As Bardin[38] (2015) indicates, the last two, are both clearly influenced by the concept of *Umwelt* brought by the German biologist Jakob von Uexküll (1864-1944) for the development of their spatial-operational

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[35] One of the most relevant elaborations around the effect of current technologies regarding space, as that emancipated from the restrictions of the human body, is found in: Luke (1996). Also see, Virilio (1991), who points out, with the advent of cybernetics, the disintegration of distances.

[36] In terms of AI techniques, this ontological collection can be regarded as a collection of objects, data points, numerical vectors, that is to say, any numerical point that can be algebraically or geometrically expressed in space.

[37] In Heidegger's case, the common structures between both domains (metaphysical-technological) can be already found in his predominant emphasis on the *spatial* field. Very few authors have dealt with the importance of spatiality in Heidegger's work (John Pickles (1985), Edward Relph (1985), David Harvey (1996), Edward Soja (1989, 1997) and Richard Peet (1998), as indicated by Wollan. This is due to the fact that, as Wollan (2003) acknowledges, most of his interpreters have considered through *Being and Time* (1949 [cf. 1927]) that it is *time* the main characteristic of his work. The structure of space in Heidegger does not particularly "occupy an extension", it also does not deal with the extensive space of things (*Zeug*) but with the possible *modes of revealing* that enable a constitutive relation with the world, a *Being-in the-world* which, as a sum, enables spatiality.

> Space is not in the subject, nor is the world in space. Space is rather 'in' the world in so far as space has been disclosed by that Being-in-the-world which is constitutive for Dasein. Space is not to be found in the subject, nor does the subject observe the world 'as if' that world were in space; but the 'subject' (*Dasein*), if well understood ontologically, is spatial (Heidegger 1962, p. 146).

[38] Bardin points out that the notion of *Umwelt* coming from Uexküll has been a contribution to ethological and philosophical studies. Regarding the latter field, his influence is to be found in Heidegger, Canguilhem, Deleuze, Merleau-Ponty, and also Simondon (Bardin, 2015, p. 160). A work on onto-ethologies from the view of von Uexküll, Heidegger, and Merleau-Ponty: Cf., Buchanan, B. (2008); for a great new collection of specialized authors on von Uexküll: Cf., Michelini, F., & Köchy, K. (2019).

notions, "Being-in-the-world" (Heidegger)[39] and "Milieu" (Simondon)[40]. These analyses constitute key schemes for approaching the modes of inhabiting or operating of technical reality whether from the existential structures (Heidegger) or from the ontogenetic operations (Simondon).

Appreciating von Uexküll's sense (*Sinn*), the *Umwelt* is the *sense gathering*, it is where patterns make sense. The best known ethological study of von Uexküll is that of the tick milieu in which the theory of the environment (*Umwelt*) is introduced. Behind it, the basic idea is that the tick's (*ixodoideos*) world is limited by three essential (*Bedeutungsträger*) "bearers of sense" which activate three operations. These three points or "bearers of sense" compose the tick's Umwelt, thereby, the forest does not exist for the tick. These three points are: i) the smell of the mammal that activates its "throwing" from a tree onto the animal's body, ii) the heat of the mammal's body that allows it to identify a suitable zone for blood suction iii) once this cycle is closed, it falls again onto some surface and activates its oviparous mode of reproduction. After that, the loop is restarted or broken in case it perishes.

For a machine learning algorithm *the human does not exist either*, the only thing that certainly exists (as a sense-bearer) (*Bedeutungsträger*) is the recognition of mathematical relationships and mathematical correlations between variables that manipulate the attributes at issue. The sense-bearer of a machine are the relations behind numerical expressions. These numerical expressions are attributes (data) that can be expressed in the form of vectors, matrices, Gaussian distributions, and others. To structure or to embed the data implies to offer

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[39] For Heidegger, neither Being nor the world exist separately from each other, but rather, it is the relationship that constitutes them, what enables spatiality and the foundation of a type of ordering, a inhabiting-mode that enables their existence. In this sense, "Being-in-the-world" can also be called "the primordial spatiality of action" (Arisaka 1995, 457 in Wollan, 2003, p. 31). There are no beings *within* the world (*das Seiende*) but contexts of reference, of involvement projected by the radical finitude of Dasein itself (p. 32).

[40] Contrary to the structural and *isomorphological* analogies employed by Heidegger, Simondon assumed an operational analogy, a *genetic isodynamism* where he no longer analyzed being in terms of fixed structures but of operations and processes of being. Simondon's genetic method aimed to reconcile the dynamic operations of machines and living entities with reality. Bardin analyzes: "Simondon [...] cancel any pre-determined «substantialist» distinction between the living and the non-living, and therefore nature and culture" (2015, p. 159).

> In Simondon's words, the world is always phase-shift and therefore «non coincident with itself», while the milieu as a 'space-one' [*espace un*] is always a partial result of a process of individuation (I 211–13). Here the crucial reference is Uexküll's concept of *Umwelt* (Bardin, 2015, p. 75). [*I* stands for ILFI in Bardin's abbreviation belonging to the first edition (2005) of Millon].

an architecture and, therefore, a hierarchy. This hierarchy can take place in Euclidean space, in hyperbolic space, hyperspace, and others. The following is an rough example of the representation of hyperspace in code:

Users > prado >

```

# Example of hyperplane projected in a 3d plot

# Import libraries
import matplotlib.pyplot as plt
import numpy as np

plt.style.use("_mpl-gallery")

# Make data
np.random.seed(19680801)
n = 100
rng = np.random.default_rng()
xs = rng.uniform(30, 38, n)
ys = rng.uniform(0, 100, n)
zs = rng.uniform(-52, -20, n)

# Make graphic
fig, ax = plt.subplots(subplot_kw={"projection": "3d"})
ax.scatter(xs, ys, zs)

ax.set(xticklabels=[], yticklabels=[], zticklabels=[])

plt.show()

```

Figure 16. Although it is not possible to visualize beyond three dimensions, this is a representation of many datapoints plotted in a high dimensional space (hyperspace). Above its code is divided in three indispensable parts, for what it is required to: i) import libraries from which it is possible to extract all its operations or select one in particular, ii) import the data and modify values if necessary, iii) to project the uploaded data in the graphic, in this case, by selecting a 3D scatterplot as offered by Matplotlib.

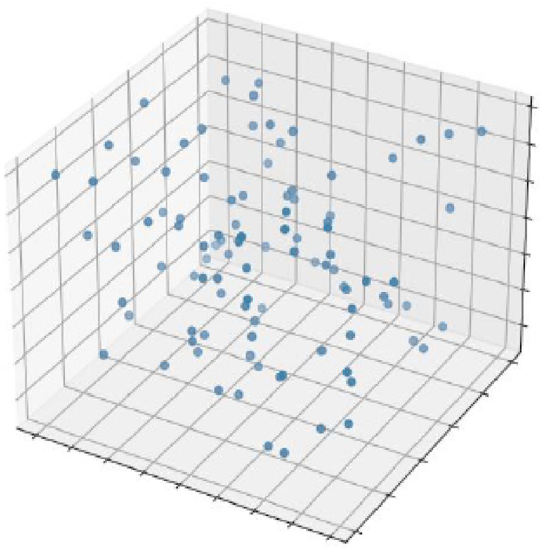

Figure 17. Output of the design (3d plot) after running the code from figure 16.

A machine learning model like support-vector machines (SVM), which has been a pioneering technique in manipulating large amounts of data before deep networks' breakthrough (2012), is a model that breaks down the complexity of the data by means of a set of functions (hyperplane equations) within an *n*-dimensional vector space. What is put into play within the set of functions, for the capture, classification, and distinction of data is the relation of various mathematical methods used in linear algebra. In the SVM's model, these methods grow from Euclidean to Hilbert's notions of space. Regarding the former, the vectors (ordered list of values) can be identified as a point in a Euclidean space (MIT, 2012). Regarding the latter, it corresponds to Hilbert's novel domain of achieving a theory of form with infinite variables, which implied bringing arithmetic and algebra together through the generalization of algebraic methods. These attempts at unification in mathematics allowed Hilbert to achieve a vector space in which it is possible to decompose an infinity of dimensions. Ultimately, what underlines the idea of "automatizing mathematics" is the recognition that the more properties are identified in the data, the more datapoints can be assigned to it and the more dimensions can grow in space. A greater identification and distribution of relationships of those identifications at the vector space finally drives to a greater the visibility of the patterns at play.

Here we detect a common occurrence that is found not only in SVM but in most machine learning techniques and any image recognition builder program, the complexity of different interrelated mathematical methods around a common plan, which is: in-*form*ing a multiplicity of data. For this, they all share three instances as pointed out by Minsky: "from separate points -to patterns- to describe their spatial relationship" (2006, p.150). *The mathematical model is the factory of relationships* that fulfill the function of integrating, differentiating, and shaping a set characterized by its multiplicity and complexity of data, that is to say, the size and attributes of the input data.

The formality of the world of symbolic-algebraic equations is not a separate and distant reality from the world of statistical equations where the patterns are rearranged. Why? Because symbols can also be broken down into patterns. Solving mathematical equations through symbolic reasoning is part of at least two practices carried out in machine learning: on the one hand, the so-called "Gene expression programming" (GEP) where a mathematical equation can be represented as a binary expression tree[41]. On the other hand, as part of a recent research

[41] An example from symbolic mathematical expression using a machine learning technique known as "Gene expression programming" (GEP) implies the conversion of symbols to the likeliness employed in probability. For example, an algebraic mathematical expression translated to a binary expression tree. For such a conversion, the

(2020) by Facebook AI by means of neural machine translation (NMT) models known as "seq2seq". The latter applies symbolic reasoning to solve advanced algebraic equations (of a single variable to date). With these neural network techniques even symbolic data used in algebraic equations such as $b - 4ac = 7$ can be decomposed into series of language expressions, i.e., predicting the probability of a sequence of words and then passing the latter into a sequence of symbols: "By training a model to detect patterns in symbolic equations, we believed that a neural network could piece together the clues that led to their solutions, roughly similar to a human's intuition-based approach to complex problems" (Charton, Lample, 2020).

There is no symbolic system (whether in algebraic mathematical expressions or in any derivation of symbolic boolean operations) that does not start from a set of arbitrary assumptions (axioms) on which to infer or derive its results. Mathematics involves submitting to prior conventions and assumptions in order to produce relations between numerical objects that will eventually be associated with the effective reality and also with cultural objects.

Working with the attributes of data mainly implies the following problems: *high-dimensional feature space, dimensionality reduction, feature learning, hyperparameter optimization*, and others. The distribution of data in space according to group-similarity/ affinity is known as *clustering* and it is applied for *unsupervised learning models*. This notion of affinity gives rise to a deep level of pattern recognition: "Clustering can be helpful as a data analysis activity in order to learn more about the problem domain, so-called pattern discovery or knowledge discovery" (Brownlee, 2020). In a different sense, yet, a sense that can be also integrated to this analysis, when reflecting on units of measurement, Simondon notably expressed:

> The search for precise and integral models of expression of the technics led to the universalization (for the purpose of homogeneity and univocity) of the units of measurement and of the internal system linking them to each other. [...]
> The more perfect the development of the symbolic system of measurement is, the higher the compatibility that achieves to put in relation perceptually heterogeneous realities (II, 155, own translation).

Machine learning is an expression of understanding methods in applied mathematics and manipulating libraries more than intervening in the code itself, but not only, it is, even

symbolic expressions under "a, b, c, d" are to be replaced by numerical values that can be weighted by the algorithm.

more, a way of organizing the contemporary patterns of the world's behavior at all levels and retaking Simondon's above quotation, of relating heterogeneous realities.

1.1. The mathematical pattern in space

The general philosophical and mathematical perspectives regarding the perplexing concept of *space* can be very roughly synthesized in: Plato's idea of granting all things a common place, a receptacle or *uterus* as found in the *Timaeus* under the concept of *khōra* (χώρα) (Heidegger, 1953; Derrida, 1990 [c. 1987]; Deleuze, 1987, Kristeva, 1974); Newton and Clarke's absolute space where space is a container of objects and independent of them; Leibniz's relational space, a relationship between objects that give rise to the existence of space, Kant's subjective space understood as a characteristic a priori of our mind for the organization of all possible experience, topological space[42], the analysis of space from the properties of the objects themselves; in set logic the space is derived from a set; non-euclidean space where the curvatures of space do not satisfy Euclid's fifth postulate; Riemann's infinitesimal conception where space is defined by the value between two points that get infinitely close to each other, and many other derived and particular cases thereof[43].

In the philosophical and cognitive field of AI, Margaret Boden, gives a definition of intelligence in terms of space: "Intelligence isn't a single dimension, but a richly structured space of diverse information-processing capabilities" (2016, p. 1). Other than space as a quantifiable measure or as the structure of information processes, one of the major media theory productions on the concept of space is the early book from Wyndham Lewis: *Time and Western Man* (1927)[44]. The British artist and critic associated the philosophies that emphasize change

[42] The ability to grant spatiality from the very properties of the objects themselves is not found in the philosophical topology of the Greeks, who confined themselves to the study of space in correspondence with concrete extensive spaces (e.g., surveying practice). This began with late modern mathematical disciplines from the 19th century starting with topology (Plotnitsky in Duffy, 2006, pp.187-208). According to, Albert Lautman, it was the work of Lebesgue and his successors, through a new conception of integral functions, that first brought the dissociation of measurement (attached by convention) to space (2011, p. 39).

[43] This is also pointed out in the *Appendix* where the discussion on space is connected to the problem of infinity. Sect., Chapter IX, §2.

[44] This substantially conservative aspect associated with space was one of McLuhan's critical influences. McLuhan's extensive work regarded space as a mode of cultural production or as a mode of social critique (Cavell,

and movement (particularly since Bergson) as "time-philosophies", characterized by their instability and subject to a mechanical process of history, while the "philosophies of space*"* are characterized by their stability, order, and common sense (Ayers, 1992).

Taking into account all these briefly mentioned different standpoints on the notion of *space*, when space is constrained to the cognitive faculties, that is to say, as the *space of experience (cognitio experimentalis)*, it is where the mind organizes its activities, locates them, gives them a form and a context, in this vein, it follows that space is a limit and a field of structuring[45]. This limitation constrains all living creatures' senses to a three-dimensional extension identified in height, depth, and length where all possible transformations between data occur. Massumi interestingly expressed: "The space of experience is really, literally, physically a topological hyperspace of transformation"[46] (Massumi, 2002, p. 184 in Mackenzie, 2017, p. 64).

Space can be both the limit, (e.g., the distance between objects), but also that which exceeds our cognitive faculties, at least factually, (e.g., a space greater than three dimensions). For both cases, mathematics is the only branch capable of expressing space (as a limit) or space (as a void). Badiou specified: "One very important consequence of this localization of the void outside consciousness is the importance of mathematics" (Badiou, 2005, p. 67). This precise but also almost poetic view may find its place in applied mathematics where ML has properly taken off.

Numerical relations, as in works of art (*l'objet esthétique*), have a modulating power that "confer spatial universality to that which constitutes it" (II, 182). In machine learning, space is born from its own attributes. Such methods capture space in a much higher number of dimensions by grouping clusters of attributes into large-scale objects. Besides the time-space

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200) from where he underlined two key characteristics: the linear, continuous and stable aspect of visual space as opposed to the non-linear, discontinuous and simultaneous aspect of acoustic space (Findlay-White & Logan, 2016).

[45] In the ancient Greeks there is a clear distinction between *space, place* and *void*. In the fourth book of *Physics*, Aristotle described place in the following terms: "place *(topos)* seems to be not only the *limits* of the vessel, but also that which is in between, which is considered as being *void (kenon)*" (4, 212a7–30, own italics). A detailed study on the notion of space in Aristotles can be found in: Fritsche, J. (2016) also in Ranocchia, et. al., (2014).

[46] To borrow again Massumi's terminology, the space of experience is captured by advanced computational learning as a *hyperspace of transformation*. Such a space of experience (which takes place through data) does not contain, so far, meaningful content (*beurteilbarer Inhalt*) nor does it contain sense bearers (*Bedeutungsträger*). This becomes a problematic debate for those models (such as common sense knowledge CYC and ChatGPT3) whose semantic representation is deeply developed.

hardware improvements as briefly described in the last section, testing different models over time also implied an improvement in the way of correlating data in space. Therefore, *a machine's cognitive evolution is closely linked to its relationship to space*. A closer observation between cognition and space was elaborated by Marvin Minsky on this subject: "Indeed, perhaps our human ability to self-reflect evolved from our developing ways to «envision» how objects behave in space" (2006, p. 125).

Minsky (1950) also designated a major role to space in relation to artificial intelligence (particularly his well-known program (*Builder*)[47] designed to learn through building-blocks tasks). Despite the fact that the design of this learning model proposed by Minsky is oriented towards the robotic branch of AI (more focused on vision and mechanical manipulation), these ideas provide a general direction of the problems that AI models broadly face. Although we cannot generalize in the face of technical precisions, the general interest in *artificial intelligence* at large, from its early days, is that of making sense of data in order to achieve *sensus communis* (common sense)[48] (McCarthy, 1959; LeCun, 2022). In a philosophical sense, the problem of space (i.e., how to make sense of patterns in space) drives the question of how to learn from uncertainty, how to extract patterns from the *void*.

Minsky descriptions of AI cognition related to space are embedded structures that arise spontaneously in our common sense (filtering an image, finding their common features and assembling them as an object) but that for automated machines require rigorous computational implementation by means of mathematical methods and computational resources. The common epistemological problem, be it to manipulate data from a physical space or to manipulate data from a virtual mathematical space, starts from gathering separated points/data (according to some affinity-type) for their final acquisition of a form or a cluster of features. This cluster of features, in a general sense, does not only form an object but might also form a *behavioral pattern*. For example, grouping and analyzing diverse data allows an insight on user's behavior (e.g., commercial customization, anticipating the cancellation of a service, risk of non-payment, identification of fraud, anticipating depressive feelings, and many others).

When data is low dimensional, it is more likely to be able to explore a subset of patterns that explain behavior (e.g., in the neurological activity and at the psychological level when purchasing items). For a mathematician this subset can be associated with the vectors obtained

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[47] Minsky clarified that this program was made thanks to the ideas of Yoshiaki Shirai and Manuel Blum. Cf., Shirai, Y. (1972).

[48] Cf., Taube, M. (1961).

after applying functions that help to eliminate less significant attributes (as explained in the last section). However, for a *social engineer*, the subset of data not only exposes a distribution across vectors, it also exposes a pattern that we can recognize as a *behavioral pattern* (Sect., Part III).

In machine learning, the (mathematical) representation of space implies learning to manipulate large amounts of data in a *virtual* space. As already described in the previous section, in order to reduce the dimensions and allow a more efficient operation in time and space for the algorithm to run, it is necessary to eliminate less important attributes. The following six points described in figures 18 and 19 are applicable to ML algorithms, coming from both the supervised as well as unsupervised methods, and only aims to roughly illustrate a very simplified summary in *three steps* of the complex dimensionality reduction process[49].

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[49] It is important to note that this applies to cases of normal distribution or Gaussian distribution, also informally known as *bell curve* which is very common in statistical modeling. A Gaussian distribution is a probability distribution, it means that most data points are distributed much more frequently closer (they converge in the middle of the range) to the mean or expectation rather than towards its extremes. Domingo explains what a normal distribution is and its complexity when applied to hyperspaces:

> What a normal distribution says is that data is essentially located at a point (the mean of the distribution), but with some fuzz around it (given by the standard deviation). Right? Not in hyperspace. With a high-dimensional normal distribution, you're more likely to get a sample far from the mean than close to it. A bell curve in hyperspace looks more like a doughnut than a bell (2015, p. 187).

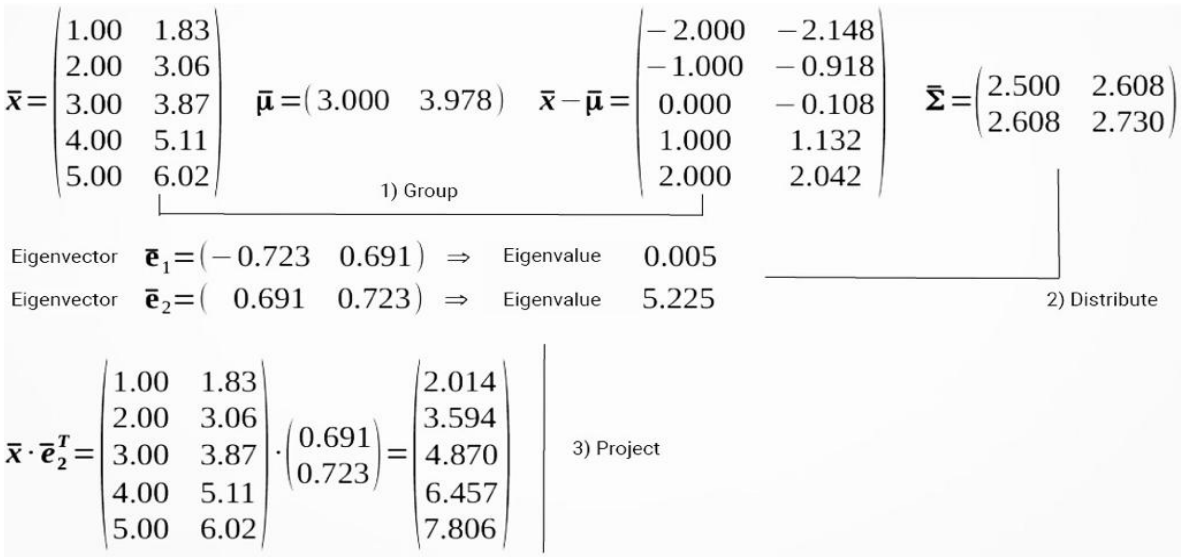

Figure 18. Basic mathematical representation of space reduction or data compression in machine learning by a three steps classification: 1) grouping data 2) distributing data 3) projecting data. Special acknowledgment to José Luis Iglesias Feria

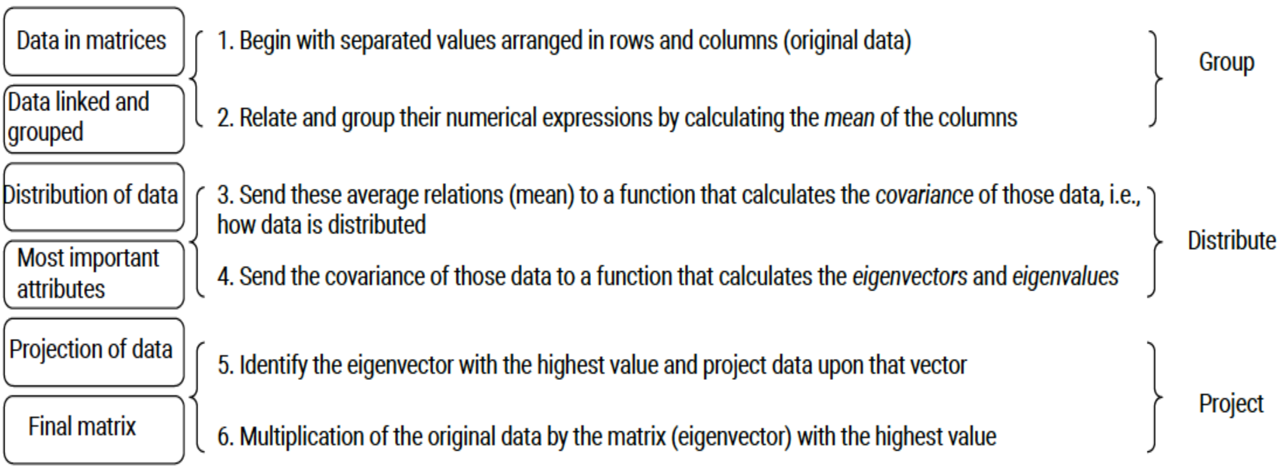

Figure 19. Basic mathematical description of the previous figure 18 where space reduction is performed by ML algorithms

Considering that we are dealing with a number of dimensions higher than what our experience of space allows us to represent, a relevant question stands out: how do machine learning techniques represent space? The representation of compressed data is what is known in machine or deep learning as "latent space":

> The concept of "latent space" is important because it's utility is at the core of «deep learning» - learning the features of data and simplifying data representations for the purpose of finding patterns [...] The *latent space* is simply a representation of compressed data in which similar data points are closer together in space. (Tiu, 2020, bold modified by italics type).

A machine representing compressed data in space invites to philosophical reflection. We shall pause to give attention to Simondon's examination in this regard. In *Imagination and Invention* (1965-1966), Simondon called "invention" to the capacity of adapting the data of the milieu to the selection of an instrument (II, 147, own translation). In this way, he managed to adapt the concept not only to human beings but also to a variety of other living species, one of many examples being the construction of leaf nests by the red ant of the tropics, *Oecophylla smaragdina.* The French mechanologist noted the *axiomatic of the invention* through the organization of operative models. Such operations take place when there is a prior *organization of space* as well as of the properties of things within it. In this sense, Simondon made explicit that *invention emerges* when, in the "translations of the dimensions and properties of things", an "implicit algebra" takes place (II, 151, own translation). That is to say, quantities of properties in space that must be distributed "either to use them if they are favorable, or to neutralize them if they are unfavorable" (II, 150, own translation).

An implicit hidden temptation would lead us to associate the current capacity of algorithms to adapt the data of the milieu to a type of organized behavior of the *inventive* type[50]. An invention in which the property of things is mathematically specialized. Simondon brings us to this conclusion slightly closer through what he expressed to underline all the models of

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[50] Very contemporary, by the way, is the challenging question of whether "creativity" even exists in today's advanced information processing: a machine, e.g., a recurrent, generative algorithm, and others, today can compose musical pieces, generate images, write literary books by adapting or transferring styles, and others. The basic question is whether the relations between qualities, properties or attributes fit the criterion of "inventive adaptation". Margaret Boden analyzes in the third chapter "Language, Creativity, Emotion" of her book: *AI: It's nature and future*, that although AI can independently generate artwork by being feed by the artist database, she answers negatively:

> AI creativity has many applications. It can sometimes match, or even exceed, human standards in some small corner of science or art. But matching human creativity in the general case is quite another matter. AGI is as far away as ever (Boden, 2016, p. 72).

technical operations, that is: the numerical-symbolic expressions of measurement: "In particular, the universalization of metrology allows to measure magnitudes and to discover constants by converting a concrete form into another from, which is a source of invention" (II, 155, own translation). In a sense, Simondon brought to light the passage from (technical) action proceeding from the technical object to (abstract) formalization or as Ferrato (2019) calls it *l'objet numérique* in terms of its measure, namely, the formalizations and reticulations of operations. True invention is the conversion of relations (functions in mathematics) between forms.

Mathematical structures[51], beyond mathematical theories and towards real-world problems, *constitute the effort of both humans and machines to gather the properties of the universe into well-defined patterns.* Here is where the mathematical function fully comes in. The latter not only allows the measuring and gathering of the elements but the mapping between two set of values; the *input-domain* and the *output-co-domain* (Mackenzie, 2017, p. 80): "We call any set that satisfies these properties (or axioms) a vector space, and the objects in the set are called vectors (Larson 1996, p. 166 in Mackenzie, 2017, p. 51).

Automatizing mathematics implies a common shared epistemological element ranging from the formal axiomatic foundations of its properties in numbers to the vectorization of the properties in data. In this sense, with automatizing mathematics we refer to a general fact: *a mathematical pattern that gives form to the data and which can be computationally discovered, processed and calculated.* This idea grows from the very Leibnizian maxim when considering his study on metaphysics: all the data of the world shall have an order that can be mathematically expressed by a formula, even when that order does not follow a pattern and mathematical complexity must be applied (Sect., Appendix).

[51] Mathematical structures applied in ML are essentially responsible for shaping models that account for partial and local, actual, and virtual aspects of reality. Within the category and relation of methods (linear algebra, calculus, statistics, multivariable calculus, differential equations, statistical mechanics), the relations between one and the other converge and express part of the picture that characterizes the unity of mathematics. After all, they are, to date, the most effective and direct techniques in terms of their correspondence with the patterns that are established and govern reality, even if this reflection implies culturally installed biases. And just as the gathering of applied methods brings to observation and examination, the fundamental ideas of multiplicity in unity, the One over the Many, that which participates in the *form*, i.e., how the diversity of data is conglomerated within a model which is based on a specific pattern, these ideas may have an ontological origin and a cultural landmark.

2.2. How black is the black box

The fundamental characteristic of machine learning, which is learning through statistically derived examples or to apply matrix algebra to data, can be examined from the technique that has enabled its evolution at its core: *pattern recognition*[52]. After all, machine learning can be defined as pattern recognition methods which are computational applicable by means of data-driven decisions. Examples of pattern recognition abound and have also become known outside the academic and scientific sphere. They became worldwide spread by the online and high-technology companies (most of them applying deep learning) and the media: recognizing patterns in faces as well as image search, recognizing patterns in speech by microphone, patterns in alphanumeric characters by images, patterns for machine translation, patterns in fingerprint analysis by scanner, online conversations by analyzing text, to name a few of countless examples.

Pattern recognition techniques have been diversified and enriched through the calculation of the measure of error commonly known as "loss function" (used for a single input) and "cost function" (used for the entire data set) although the terms are usually employed interchangeably. Precisely the error, the genealogy of the error or as Pasquinelli calls it "the grammar of error" is what is associated with what is called "learning". When a function maps from the inputs to the output domains, the error is corrected by modifying the values of the model's parameters. For example, for some models (linear models) the *weights* are the parameters, for others (regression models) the parameters can be *thresholds*. In a few words, the adjustment of the parameters is what is recognized as learning: "Learning corresponds to adjusting the parameters so that the model makes the most accurate predictions on the data" (Alpaydin, 2021, p. 46). Thus, for each type of error there is a different learning process, and

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[52] The historian of machine learning, Mendon-Plasek, has developed a genealogy or historical analysis of pattern recognition, taking as a starting point the period of the 1950s and 1960s with OCR research (optical character recognition). Based on his reading of Shapin and Shaffer (1985), Plasek points out that such technical problems not only respond to classificatory tasks (e.g., distinguishing symmetry and asymmetry of alphabetic and numeric letters) but to problems of the social order itself. In line with this idea, the author cites as an example Google's Perspective API whose purpose is to detect "toxic" and "offensive" comments in the various networks and platforms. On this basis, he differentiates the epistemic values to be taken into account for pattern recognition: *contextual significance* (distinguishing data according to context, how certain data can be or can be not perceived as toxic), *contextual robustness* (being able to continue the distinction with previously unseen data, how new data can be perceived as toxic), and finally *ignorance-as-generality* (probabilistic distinction of data, how the distinction of toxic resides in a probabilistic distribution) (Plasek, 2021, p. 36).

therefore a different pattern-formation useful for the context and problem at issue. John Kelleher explains:

> One way to represent a function is to use a neural network. Deep learning is the subfield of machine learning that focuses on deep neural network models. In fact, the patterns that deep learning algorithms extract from datasets are functions that are represented as neural networks (2019, p. 8).

In this learning procedure (defined by statistical distributions and error measurement) *there is not only* a distinction and categorization of input-examples with respect to a function and the estimation of its parameters, still, at a deep level, what is occurring is the processing of opaque information to the human agent. This is recognized by Andrew Pickering (2010) in terms of the "black box ontology". This is found in Mendon-Plasek study of pattern recognition in his quotation of Pickering:

> Mid-century pattern recognition shared with mid-century cybernetics what Andrew Pickering calls a "black box ontology," in which the world is filled with black boxes "that [do] something, that one does something to, and that does something back," and for which its internal workings are opaque to us (2021, p. 40).

This is in line with the evolution of data. Before machine learning, data played a passive role, it was processed by *a program whose behavior* was completely *known* by the programmer. Nowadays the data has taken an active role. It is the data what shapes the program for its improvement, but in exchange, its behavior is not completely known by the programmer: "Before, data was what the programs processed and spit out- data was passive. With machine learning, data starts to drive operation; it is not the programmers anymore but the data itself that defines what to do next" (Alpaydim, 2021, p. 12).

Without a priori knowledge of the behavior pattern, there is also no knowledge of the rules or the programs to predict it, hence, as Alpaydin explains, in machine learning, the rules are extracted from the data themselves (2021, p. 14). In this sense, it is usually found in most literature that machine learning does not use conventional programming with specified rules by the programmer (as symbolic AI/GOFAI did) but big data processed by the so-called "black boxes". It is appropriate to clarify that machine learning does not always apply black box algorithms, for example: linear regression (Galton[53], 1894; Pearson, 1896, Montgomery, et. al., 2021 [c. 1981]) and support vector machines (Vapnik, 1998), k-nearest neighbors (KNN) (Fix, et. al., 1989) are not black box algorithms.

Unlike the black boxes of early cybernetics in which it was possible to scrutinize every input-to-output mapping within it, in deep neural networks that is not the case. The values of the inputs and their interactions with other inputs involve nonlinearities or a nonlinear function of the input, this means that the values of the inputs do not follow a succession that we can clearly deduce because such computation may involve billions of numbers. And although we can "open the box" for accessing a partial observation and review each value, because of the large-scale, namely, the depth of calculations of its layers (from what deep learning gets its name), there is no human lifetime able to devote to such an inspection.

Another distinction comes into account: "[d]eep learning models, for instance, tend to be black boxes [...] because they are highly recursive" (Rudin, 2019, p. 206), in this context, this implies that the processing of the mathematical function is hardly understandable by humans. To review each node and its values would be equivalent to undertaking the task of the Borgian Empire as described at the beginning of Part II. In other words, the interaction of inputs involves more of a reaction to external stimuli rather than logical deliberation (Dallas, 2017). When referring to search engines in relation to his simondonian study, Rieder (2005) considers that the use of the term "black box" became highly inaccurate and proposes to switch it to "black foam" since it is completely unknown even the object in the box itself, an object which, lacks a beginning and an end and which is composed by many opaque and complex subsystems (2005, pp. 28,29).

Now, in the face of deep learning neural networks (LeCun, Bengio, and Hinton 2015; Schmidhuber, 2015, Goodfellow et al., 2016), we are at a decisive phase in which the process has become so inscrutable or "opaque" that the mathematical models at play can no longer be clearly explained or interpreted. Alpaydin explains: "[...] we do not know what structure there is in the input, especially as we go up and the corresponding concepts become «hidden»", and yet, "[i]t is this extraction of hidden dependencies, or patterns, or regularities from data that allows abstraction and learning general descriptions" (2021, p. 128). This, which might seem

[53] It was Galton, Darwin's cousin, as recalled by Simondon, who first applied statistics to psychology, which fits into the field of differential psychology (*psychologie différentielle*). Later, the Belgian mathematician Quételet studied the distribution of individual differences of a large number of individuals through the Laplace-Gauss law: "The bell curve reflected a concentration of subjects around the mean value and a decrease towards the extreme values" (Simondon & Le Terrier, 1957, pp. 1684, 1685). This is also what we explained already in footnote 51.

to have the scent of mystery, is something that Leibniz had already noticed, of course independently of these technologies, and which Hannah Arendt elaborated in the following way when referring to mathematics:

> [...] every assemblage of things is transformed into a mere multitude, and every multitude, no matter how disordered, incoherent, and confused, will fall into certain patterns and configurations possessing the same validity and no more significance than the mathematical curve, which, as Leibniz once remarked, can always be found between points thrown at random on a piece of paper (1998, p. 267).

Arendt was ahead of her time. Her words today have an even greater implication.The image of the world has become the image of automated patterns, of distortions of the relations between, as remarked by her, a "mere multitude". This much data becomes a mere multitude.

In the multitude, terms are often confused. The metaphor of the "black box" and the unexplainability in machine learning have both been entangled in a great confusion mostly at the theoretical level. One of the earliest uses of the term "black box" come from its application in studies of network theory and electrical systems in the second half of the 20th century, that is, for the application of vacuum tubes (e.g., magnetron) and electronic circuits[54]. The expression "black box" captured the attention of early cybernetics, particularly, in Rosh Ashby's meeting with Norbert Wiener in 1951. The articulated ideas of Wiener came originally from the engineering research of control systems such as Mindell in his book between *Human and Machine* (2002) extends: naval control systems, the machinery and new feedback systems designed in Sperry Company, the transmission of signals and black box at the Bell Labs as well as analog computing at the MIT (Mindell, 2004).

In his private notes, Ashby described how Wiener referred for the first time to "the problem of the black box" due to the example of a box which, between the input-output chain, was characterized by its *unknown electrical content* (Ashby, 2008). Over the years, by 1956, Ashby was already referring to the black box concept in a rather general way as other cyberneticians did including Norbert Wiener, Stafford Beer, and W. Grey Walter: an effective method in complex systems for obtaining information through feedback processes with fewer errors (*lessened feedback*, was the term used by Ashby), few loss information, and also, without

[54] For the detailed origins of the black-box history in the cybernetic context, Cf.,: (Petrick, 2020).

revealing the inner workings, the internal logic or internal structure. For Wiener, in turn, this implied the beginning of self-organized behavior, the ability to modify the internal structure in response to external events or stimuli.

In a general sense, the black box is mainly associated with the *unknown* interaction between the stimulus and the response, i.e. the connection of the interaction of the object in the box with its environment. The Argentine physicist and philosopher Mario Bunge defined in 1963 a general black box theory as follows:

> A black box is a fiction representing a set of concrete systems into which stimuli S impinge and out of which reactions R emerge. The constitution and structure of the box are altogether irrelevant to the approach under consideration, which is purely external or phenomenological. In other words, only the behavior of the system will be accounted for (p. 346).

Still, rather than a fiction the black box constitutes a metaphor that fits for different problems based on a model (be it physical or mathematical) upon which theory derives. The behavior of a system with opaque information-processing leads to the notion of unpredictable behavior. And the lack of explanation of the system's behavior rises as a crucial ethical problem[55], for example, when a black box system provides high stakes decisions such as a medical diagnosis, criminal justice, energy reliability, the eligibility on a loan or credit scores, to cite some of the most well-known applications. It is at this point where accurate explanation becomes crucial. Hence, *explainability* constitutes the understanding by a human of what a machine learning model is doing from the input to the output (Onose, 2022). The explanation implies creating a second model (a post hoc model) able to explain the initial black-box model which, because of its simplification, can lead to the disadvantage of inaccuracy (Rudin, 2019). This is one way of proceeding in the field of machine learning, the other alternative is using *interpretability,* the so-called interpretable models[56]. These imply the possibility of humans to explain the reasoning processes behind models which can call for: causality, logical structures, linear-modelling, or case-based reasoning, among other domain-specific uses.

[55] Cf., (Guidotti, et. al., 2018) where they offer a survey of methods explaining the black box models.

[56] As Rudin argues, the widespread use of explainability of black box models rather than interpretability of models can have a lasting negative impact in society (2019, p. 206).

The problems involving explainability or interpretability, according to Cynthia Rudin, started at least in the early 1990s (2019, p. 206). This was followed in the mid-1990s by the spread of the idea coming from the ANN community (Hecht-Nielsen, 1998, and others) of machine-reasoning surpassing human capacity owing to the very high and opaque level of neural network architecture. With the increase of complexity in the calculation of layers, also emerged the conception of the programmer who, although having built the neural network model, the programmer itself can neither understand nor explain the results outputted by the sophisticated ML model. What began for over thirty years still adds fuel to the fire. This can be reflected, for instance, when referring to automated systems as the "the unknown" or as something "beyond the limits of reason or knowledge" (Beer, 2022) while posing principles of uncertainty or indeterminacy (Parisi, 2015, 2021, Yolgörmez, 2021) as a new dynamics in artificial intelligence systems (neuron-based) as distinct from the preceding ones (based on predetermined rules). There is indeed a new narrative to be explored in advanced automation systems, yet, these metaphors drawn by the difficulty to explain and interpret the mathematical models produced by algorithms may also have gone too far.

What is exactly the very "unknown" from human-perspective in such a case? Simondon's creative rectification through general technology (*allagmatic*) precisely aimed at establishing new relations with the operations coming from the black box of our civilization. As Guchet (2010, p. 80) greatly analyzes, Simondon's analysis contains the need for societies and machines to enter into the same general scheme, which is no longer teleological or technical, but even more universal, techno-logical. Within the darkness of the box, Simondon recognized not the technical ignorance of the individual (not knowing for example how particular technical objects work) but rather its own alienation. As described by Guchet: "the individual is dealing with a form of alienation that makes society appear as a new nature, over which he has no control and whose constructive operations remain very obscure" (2010, p. 79, own translation). Without referring to black boxes, Simondon had already alluded to the process of ignorance or no-control with respect to the technical object itself:

> [I]ndustrial production misleads (*écrase*) man because it places him in the presence of objects that are not immediately clear to him; they are *very close to him* as objects of use, but they are *alien* (*étrangers*) to him because they are not easily decipherable, and because human action no longer knows how to find its points of insertion (PST, 65, own translation).

At a more evolved stage of industrialization, the contemporary hyper-industrial epoche, we have completely lost control of the operations that information undergoes and how society is shaped by it. But, to return to the major problem, having difficulties to explain or interpret automated mathematical models may have no clear bound with the displacement of knowledge or of reason or even subjectivity itself. This might rather be a symptom of what we already discussed in the *Prolegomenon section*: displacing human reasoning belongs to the anti-logocentric and anti-metaphysical drives. We wish to stay away from obscure metaphors. In truth, there is no displacement at all. The reality that "used to" (still is) to be described by mathematicians through abstract models (mathematical modeling), i.e. differential equations, formulas, distributions, today can be described (and more accurately in most cases) by machine learning algorithms. What is not clear at all is the entire mathematical process used by these algorithms to produce such models. In other words, the problem of displacement, if any, would lie in *who and how can best represent the world mathematically* but it is doubtful, to say the least, that black box models transcends or surpasses *reason* in terms of conscious representation itself. Still, who can best mathematically represent the world might govern reality in its utmost sense. Why? Because the pattern governing the phenomena in question becomes unveiled.

As machine learning evolves, the greater the opacity regarding how the information is processed. That is, the more automation progresses, the more it escapes our horizon of logical-causal explanation: that is, we do not understand what led a program to make a decision (even though that decision is surely the correct one). This level of automation moves away from the logical and conceptual scheme while entering the order of the opaque statistical methods. On the one side, Judea Pearl, the father of Bayesian networks and winner of the Turing Award, and on the other side, Georg Dyson, the most well-known historian of science and technology, are both aware of this problem and wrote (separately) in the same edition:

> As a former physicist, I was extremely interested in cybernetics. Though it did not utilize the full power of Turing Machines, it was highly transparent, perhaps because it was founded on classical control theory and information theory. *We are losing this transparency now, with the deep-learning style of machine learning.* It is fundamentally a curve-fitting exercise that adjusts weights in intermediate layers of a long input-output chain. I find many users who say that it "works well and we don't know why." Once you unleash it on large data, deep learning has its own dynamics, it does its own repair and its own optimization, and it gives you the right results most of the time. [...]

> I know that nontransparent systems can do marvelous jobs, and our brain is proof of that marvel. (Pearl, 2019, p. 39, own italics).

> You don't need to fully understand how a brain works in order to build one that works. This is a loophole that no amount of supervision over algorithms by programmers and their ethical advisers can ever close. Provably "good" AI is a myth. Our relationship with true AI will always be a matter of faith, not proof (Dyson, 2019, p. 63).

As we remarked earlier, the spark of evolution in artificial intelligence rests on uncertainty and potentiality. The increasing opacity of the programs is limitedly analogous to the opacity of the human neural architecture itself. As the chains of patterns evolve, achieving more complex forms of organization for larger amounts of data, becomes every time more a manifested reality.

CHAPTER VI

The historicity, use, and technicity of machine learning

§ 1. Evolutionary cycles of the technical object

How to identify the *coming-into-being* of the technical object? Simondon replied by focusing on its genesis: “The genesis of the technical object partakes in its being” (MEOT, 26). Genesis and being are precisely at the core of his theory: “[The] genesis can account for the being, the individuation of the individual” (ILFI, 193, own addition in brackets), it is the “unity that encompasses plurality” (ILFI, 304). The unity that the genesis provides to technical objects is a force and method of production of dynamic internal-external relations, it is the condition of possibility for structures and functions of the technical object to be always in a state of becoming: “the technological paradigm is not without value and that to a certain extent it allows us to think the genesis of the individuated being, but only [...] *through the energetic system* of form-taking” (ILFI, 31). This bears the question, what is then precisely the essence of technology in these terms? Simondon answered: “The essence of the technology lies initially in the method rather than in the object” (IDT, 86, own translation).

After these assumptions, we may fairly gather, then, that the «genesis» acts as the unifying point of emergence, as the method, and as the very essence of the technical object. This is a key to conduct a proper genetic analysis of technological evolution at the current state of the art. How to clearly identify the genesis, is the next pertinent question. The French philosopher continued:

> The technical object is that which is not anterior to its coming-into-being, but is present at each stage of its coming-into-being; the technical object in its oneness is a unit of coming-into-being. The gasoline engine is not this or that engine given in time and space, but the fact that there is a succession, a continuity that runs through the first engines to those we currently know and which are still evolving. As such, as in a phylogenetic lineage, a definite stage of evolution

contains dynamic structures and schemas within itself that partakes in the principal stages of an evolution of forms (MEOT, 26).

The technical object, therefore, is distinguished through three fundamental characteristics: its *being* resides in its genesis, it is modified in the progress of its genesis, and it is distinguished according to the technical species to which it belongs. This indicates that in the genesis lies its structures, functions and schemes. Genesis can also be grasped as the convergence of forms preserving potential of transformation. The product of that convergence is evolution: the passage and integration from one form into another. Thus, the machine in its most abstract and philosophical sense is the integration and interrelation of diverse structures and functions belonging to diverse species and lineages.

The development of the technical object ranges across three levels: the first one is where the object is situated as a functionally useful mediation and requires the operator as supplied energy (e.g. the case of the hammer)[57]. The second level is the technical object as a tool-bearing machine (*machine-outil*), whose evolution is not linear but dialectical, in this context, the machine receives information from the operator but functions with energy taken from the milieu (e.g., the case of the internal combustion engine). These two first cases are heteronomous and prosthetic since they are directly associated with human mediation for general *signal reception*. But furthermore, they are symbols of life (*symboles de la vie*), that is to say, there is a relation with them as concrete objects of ownership (*appartenances*). Finally, the third level of technical reality or object implies the possibility of a higher level of automation, a networked technology[58], coextensive with the milieu and capable of internal regulation and autocorrelation

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[57] Simondon, in turn, differentiates *tool* from *instrument* in his text “L'invention et le développement des techniques” (1968) in the following way:

> The tool is a mediator of massaged action, planned by an operator equipped with knowledge. It is essentially mobile like the operator whose effectors it extends and adapts. As for the instrument, it is the opposite of the tool, because it extends and adapts the sense organs: it is a sensor, not an effector (IDT, 88, own translation).

[58] Despite Simondon’s visionary character about technical evolution, we have to remember the fact that, at that time, the internet had not yet been part of his narrative horizon, a technical network for Simondon implied, for example, stations connected to a computer (a terminal). In his seminar: *L’invention et le développement des techniques* from 1968 to 1969 Simondon noted: “the development of a network (*réseau*) leads to the plurality of exchanges and their interconnection” (p. 114), where the network (*réseau technique*) implies, for example, the

(*autocorrélation interne*) for problem solving, this is the case of the information machines and technical networks (*les réseaux techniques*) (IDT, 85-95). Information, in a fully contemporary sense, is a non-thing, a non-object, not able to be possessed but rather *accessed* and which, by not having any duration or stability, does not allow for *any experience* either (Han, 2022). Digital information together with automated processes are rooted on this level. They are non-experiential and hand-less: “Artificial intelligence transforms things into informatons” (2022, p. 8). At this third level is where, precisely, technology matches up with progress, Simondon wrote: “Technical progress is realized through a dialectical relation between mediation [...] and autocorrelation, the relation of the technical object to itself” (IDT, 96, own translation). The relation machine-to-machine, the hyperhistorical state of machines, is also a relation of the machine to itself. Machine’s essence is purely genetic. It is in the relation to itself that the technical object gives rise to uncertainty.

Simondon posed the idea of uncertainty along with the idea that he recovered from Bergson, the open machine in the “Complementary Note on the Consequences of the notion of Individuation” (1958), in MEOT (1958) and in “Psychosociology of technicity” (1960-1961). In these works he expanded the idea of the evolution of the machine with respect to its structure, its limitations, its uncertainty, and the information it acquires. Against the trend of those who force the idea of the intelligent or super-intelligent machine as a sign of the perfect automaton, he stood against it while supporting the recognition of the machine as technical individual, namely, as the one who essentially has to take the place formerly occupied by the human (that place is the industrial work in his context). Simondon argued that if the automaton is a perfect automaton, it has a functioning that repeats itself indefinitely, and thereby, the greater its autonomy, the smaller its margin of indeterminacy. This means that its high degree of autonomy reduces its possibility of variation. Now, when the machine requires external regulation, it requires skilled human intervention as the main interpreter (the mechanologist). This integration of information-bearers (human-machine) is what enables its margin of indeterminacy and therefore its expansive evolutionary potentiality. Certainly this raises to an even more complex level: “Technical ensembles are characterized by the fact that in them a relation between technical objects takes shape at the level of the margin of indeterminacy of each technical object’s way of functioning” (MEOT, 157). Simondon was, under this quote, already discovering hyperhistory (Sect., Prolegomenon, Chapter II, § 3.).

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technical network of the mine whose operational centralization allows the development and progress of other inventions such as railways, locomotives, steam engines (IDT, 163, own translation).

In the course of technological evolution, technical objects were beside classified by Simondon according to; their use[59], their historical character[60], and their technicity[61]. A technical object is not merely a product of historical-temporal events, in which one invention follows another in a linear, continuous and sequential fashion. The technical object is, instead, *an organized reality*, capable of amplifying, evolving or transforming its relations according to how it modulates *information* with its *milieu* (Sect., Part I, Chapter III, §2, 2.1.). When Simondon considered the coherence of the technical object, he thought of causal actions and exchanges of information according to regimes and structures of functioning. And such a regime of functioning implies relations (*rapport*) in its coupling (*couplage*) between the milieu and the human. Thus, the machine assumes the representative basis of the third reality type, the

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[59] Simondon, differentiating himself from Heidegger, restores the very essence of the technical object: "Heidegger, the one who makes technical objects *utilia*, utensils that have no other nature but to respond to a practical purpose. [...] But it would be better to know them according to its true nature, which is not only its usefulness". (PST, 74, own translation). The desacralization of technical objects, because of being condemned to a mediating existence, places modern human in a situation of dissonance between culture and civilization.

[60] In the analysis of the socio-cultural aspects of the technical object carried out by Simondon, namely in *Psychosociologie de la technicité* (1960-1961), the author connected this cultural external appearance of the produced object with two underlying dimensions: its *historicity of use* and its *psychosocial historicity*. In the first instance, the technical object is defined by the need for the *l'ustensile en tant qu'ustensile* (utensil as utensil), i.e. its mere and concrete use. This condition of use is in turn interfered with by the second instance, i.e. the psychosocial aspect of the object understood as a historical being, dated by an approximate or specific date of manufacture. Both of these aspects, their use and their historical reference, underlie the passage of a technical object over time and culture. This significant distinction between the *use* and the *time* of any technological object is not only linked to the quality of use over time, that is, its degradation, but in a more fundamental sense, its use can either belong to a defined civilization or it can pass from one age to another.

[61] In the various works where he approaches the technical object, Simondon thematizes with examples of the operations coming from: electric motors and combustion engines, gears, batteries, radars, aeronautical constructions, funiculars, trams, locomotives, tractors, ships, automatic machines (e.g., chess player), electrical generators (e.g., Gramme machine), relay, photo cameras, valves, vacuum valves, oscillators, amplifiers, switch and electrical distributor, radiotelegraphic transmitter, and many others. The *modulation* of the information of these technical objects can be expressed in various ways: electronics, electricity, mechanics, thermodynamics (temperature, heating), chemistry (harmful chemicals), biology (organisms that degrade matter) and psychophysics (physical stimulus and sensitivity caused in the senses of the observer). Therefore, they can be expressed under different *information systems*: electric currents, mass conservation, heat exchange, electronic flow, cathode and anode connections, electrostatic insulation, order of magnitude, photoelectron flow, sound frequency, bandwidth, and many other working forces. As expressed by himself, a technical object can serve as a model for operations of various kinds: technical, natural or physiological (LRA, 183, own translation).

welding (*soudure*), the paradigm of relations between the human being and the world (IDT, 83 - 85). As it evolves, the technical object crystallizes the human gesture while engaging itself with *language, work and life* schemes. What Simondon attempted to emphasize with this *is not the displacement of the human by the machine* but the universal tendency of technical objects to incorporate, modify and reproduce the human gesture, to *crystallize* human reality.

If, as written before, the genesis constitutes the essence and unifying force of all technical objects, how does its evolution come about? The trend towards the universality of the technical object requires an evolution that originates in the abstraction: “As with any evolution, that of technical objects poses the problem of its absolute origins” (MEOT, 44). For example, craft and agricultural production corresponded to a *primitive, abstract, ecological, and temporary state of technical objects.* The production of objects was not specialized (namely, everyone knew how to accomplish various tasks), it was also mediated by direct contact with the natural milieu[62], and also, was not capitalized over time (that is to say, the craftsman could take as long as necessary to form a vessel with his own hands).

This abstract scheme born from the internal representation of the vessel held by the craftsman is later followed by the subsequent industrial and manufacturing phase: a *modern, concrete, independent, and spatial state of technical objects*, given by the standardized and specialized evolution of technical objects with the help of energy sources supplied by machines (MEOT, 28- 29; PRE, 234- 235). “For industrial age techniques, the picture changes: the organization consists essentially in creating an exchange between different technical individuals as perfected as possible” (CC, 81, own translation). The perfection of the industrial machine implies that its different parts can exist independently, for example, in the case of the *steam engine*, Simondon writes: “the furnace is possible without the boiler, the boiler without the steam engine or the pump" (CC, 81, own translation) but at the same time, they exist incompletely, for example, the textile factory needs boilers, and boilers need coal (CC, 84, 85, own translation).

At this level, the spatial variable strengths because the worker repetitively performs the same tasks over time while being concentrated on a specific place, around the installation of

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[62] At the pre-industrial level, Simondon saw a clear association with ecological milieus:

> At the pre-industrial level, which does not require invention as such but rather an organization, the communication between technical objects and the milieu is of an ecological order; the wagons in the mines communicate with the milieu, sometimes muddy, sometimes stony, by means of wooden rails and beams (CC, 81, own translation).

industrial energy sources (thermal and thermodynamic energy sources). This change of values in the parameters of time and space allowed the emergence of *cities*, which also marks a clear division of technics and nature from each other: “It was necessary to transform the temporal range of agricultural work into a spatial, morphological range of industrial work” (ST, 235, own translation).

What is superficially transformed in the passage from handcrafted to industrial technical objects is the way in which energetic exchanges (technical) and costs (economical) take place. Still, what really underlies this radical change is, according to Simondon, the *transformation of information exchanges.* This changes everything. The industrial technical object, as today artificial intelligence, acquires “the power to shape a civilization” (MEOT, 29). Since then, the relations between thermodynamics and information processes never cut their ties, giving rise later to the communication and information revolution in networks (TCP/IP).

In our post-industrial, hyper-industrial, fourth industrial revolution or as Floridi (2014) calls it “revolution 4.0”, purely based on information processes, the technical object returns to an abstract process: automation itself is automated. However, this return is not channeled in time but reinforces and modifies the process of spatialization (*spatium*). The technical object is no longer subject to the temporal contingency of a craftsman, nor to the spatial standardization of a factory, but is distributed in a way that is both objective and indeterminate. Even more than in previous stages, technological progress involves uncertainty: “technologies progress by a series of refinements, halted by obstacles and overcome by innovation” (Lloyd, 2020, p. 8). In the case of AI, the limitations of a certain automation or learning paradigm are constitutive steps and precedents of the next paradigm, since far from limiting it, they enable its evolution.

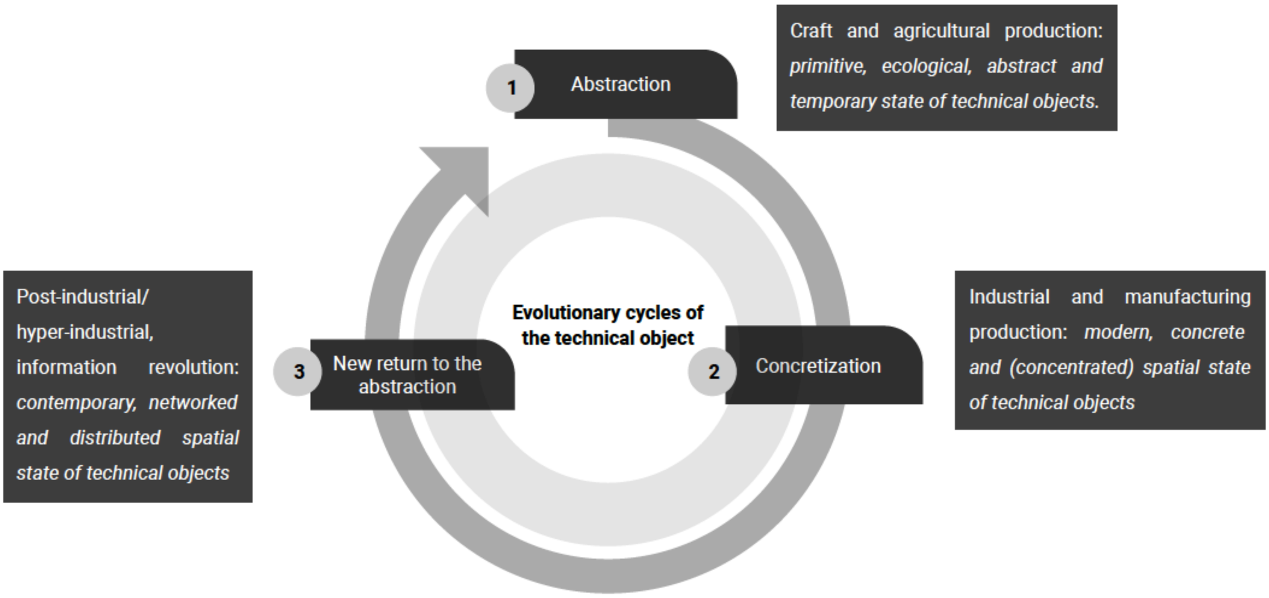

Figure 20. Evolutionary cycles of the technical object according to three phases: craft and agricultural production, industrial and manufacturing production, and the current, post-industrial or hyperindustrial production.

In the latter phase, when automation is automated and the production of information predominates, we can build on by means of Simondon: "It is no longer with the milieu that the object communicates, it is with itself" (CC, 82, own translation). Production is no longer merely concrete but also abstract. What is produced is not just the technical object (to be used) but what, to begin with, *motivates the production of the object* in the first place: the *automated cultural patterns* driven by attention itself, the well-known and very contemporary "economy of attention" (Sect., Part III). The systematic distribution of algorithms in any information process is an abstract producer of patterns that shapes and guides our *Umwelt* of cultural features: interests, opinions, searches, desires, fears, and others. The object is no longer simply produced, in a different and abstract turn, the underlying attention is guided by the user to seize it (Sect., Part III). The more attention is invested on particular objects or services, the more their production flourishes.

The true factory of production is an abstract factory operating with large datasets. Reasons of fact are not reasons of cause. Whether economic trends are aware or not to take advantage of it, is a contingent but not essential fact. "[...] neither an economic theory nor an energetic theory can account for such a coupling of man and machine" (MEOT, 135). In the case of ML applied technology, it is a highly lucrative type of technology at use, but even so, that is not the essential cause of its evolution:

> If technical objects do evolve toward a small number of specific types then this is by virtue of an internal necessity and not as a consequence of economic influences or practical requirements. [...]
> As far as these two types of cause - the economic and the properly technical- are concerned, it would appear that it is the latter that predominates in technical evolution; economic causes indeed exist in all domains; yet it is mostly within the domains where technical constraints prevail over economic constraints (aviation, military equipment) that become the most active sites for progress. Indeed, economic causes are not pure; they interfere with a diffuse network of motivations and preferences that attenuate or even reverse them [...].
> The specific evolution of technical objects occurs neither in an absolutely continuous nor completely discontinuous manner; it is made up of stages that are defined by the fact that they produce successive systems of coherence. (MEOT, 29, 31, 32).

As indicated in this quotation, the coherence of systems implies that each technical invention serves as a support for the next, thus exposing its nature to open transformation and technical progress. In other words, the successive evolution of technology always contains previous technological forms, it is genetic. In one of his examples, Simondon described a tractor as a universal tool-bearer because it is powered directly from mechanical energy by the engine (II, 199). Driving towards a more contemporary example is that of the cell phone (smartphone), as we know it today, which contains embedded within itself multiple machines (digital camera, telephone, messaging system, commercial transactions, and many others). As it progresses, the technical object has a tendency to universalize, it contains many machines within itself. This matches with the already communicated idea, machine-to-machine relations is a relation of the machine with itself. Hence, as the machine evolves, it modulates and amplifies more complex realities while differentiating itself at the same time. This "container" or *χώρα* characteristic of the evolution in the machine gestates a very *uterine* image of technicity.

As we already expressed, the evolution of technical lineages is not unilateral, nor does it imply an evolution by successive stages, nor can it be presented taxonomically. Simondon added further: [Technology] "presupposes nothing, it refers neither to a previous tradition nor to a revelation: it is self- justifying, and becomes the most adequate symbol of a group discovering its dynamism and power of expansion" (PST, 344 in Bardin, 2015, p. 200). For Simondon, technological evolution is engendered from its own limits serving multiple interactions in asymmetrical and simultaneous ramifications and, it is even more, as we wrote, a crystallization of the human gesture. Despite the multidimensionality of the problems to account technological progress, Simondon underlined a clearly discernible aspect: "Human history is deposited in the machine" (PIT, 205, own translation).

Following this epistemological thread, what we could assign as "evolution" or "progress" in the methods and algorithms from AI refers rather to a set of previous human actions crystallized into processes of automatism. It is valid to infer that the evolutionary development of the automated machine mimics the genesis of the individual, just as the mental development of the individual mimics the genesis of patterns (archetypes) found in society as a whole (ST, 224). In an utterly platonic sense, every form tends towards a form that is originally (*ursprünglich*) more universal.

§ 2. The enterprise of reproducing reality

The ever-evolving reproduction, distortion, and continuous production of patterns seems to *mask the simulation of the real and its becoming*. Simulation can also be called *modeling*. Modeling does not occur at an anatomic level, as exemplified by Margaret Boden: just as it does not have to rain inside the computer in order to model the weather, nor does it need hormones or neuromodulators to model emotions, in the same way, artificial intelligence does not need chemical diffusers to modulate cognitive faculties (2016, p. 95).

The contemporary state of AI, recognized through the label of "machine learning" is based on the unification and hybridization of methods (which does not imply displacing the previous symbolic AI methods[63]), especially those coming from parallel distributed

[63] The early enthusiasm of the media and the academic field in the development of *symbolic AI*, which partially succumbed to its application in the market through expert systems in the late 1980s, attracted special interest in philosophy, and in particular, the phenomenological field and the philosophy of mind. In the field of philosophy, Symbolic AI was capitalized in the figures of Hubert Dreyfus (1972) and John Haugeland (1978), who, with skepticism, sought to stop the misleading analogies, coming from the computational field, between human and machine's cognitive's abilities.

computation: multilayer probabilistic networks (artificial neural networks) and deep learning techniques[64] (Boden, 2016, p. 20). While early philosophy on symbolic AI sought to stop the misleading human-machine analogies (also fitting Simondon's purposes), currently, it seeks the trend of how to co-evolve, merge or converge with increasingly realistic simulation technologies. We are accessing the terrain of what Plato called "image makers" (είδωλοποιός), purely based on copy, imitation, and unreal appearance, or borrowing Baudrillard's expression: "a gigantic enterprise of pseudo-objects and pseudo-events, which is invading our daily existence, as a denaturing or falsifying of an authentic content" (1998, p. 126). The limit at stake is no longer as much epistemological as it is purely a *cultural drive* (Sect., Part III).

Modeling (which can derive in an endless number of techniques) abstracts its potential from the virtuality whose roots are to be found in mathematics and the relationships underlying it. It is already possible to *model*, to *simulate*: development in living organisms, brain development, neuromodulation, logical reasoning, planning, heuristic and goal-achieving tasks, all types of design experiments, energy conservation and dissipation, ecology of a forest, a non-existent face based on data from other faces, an existent face is possible too, a voice that functions as an assistant, empathy and emotions in communication, the anticipated behavior of a user, the many economical and political decision-making scenarios, and many other *quaerendo invenietis* simulations[65]. *The great political and cultural battle of this time arise*

[64] Stuart Russell reminds us of the breakthrough of deep learning in different areas of AI computation: "[u]nder the headline of "deep learning", they have revolutionized speech recognition and visual object recognition. They are also one of the key components in AlhaZero as well as in most of the current self-driving car projects" (2010, p. 47). A more extensive list of examples is to be found in LeCun, Bengio, Hinton (2015).

[65] This has been expressed by Baudrillard in the following manner:

> It is in the *form* that everything has changed: a neo-reality has everywhere been substituted for reality, a neo-reality entirely produced by combining elements of the code. Over the whole span of daily life, a vast *process of simulation* is taking place, similar in style to the 'simulation of models' through which the operational and cybernetic sciences work. A model is 'built' by combining features or elements of reality, and an event, a structure or a future situation is 'played out on' those elements, and tactical conclusions are drawn from this with which to operate on reality" (1998, p. 126).

from the problem of the indistinction between reality and simulacrum[66]. Thereon Simondon wrote:

> In other words, archaic cultures are centered at the level of action, according to a perspective of projection into the future (*de projection vers l'avenir*), classical cultures are based on perceptions, they are essentially plastic, constructing a real object, *while cultures in their decadence* (*déclin*), instead of inciting action or establishing perceptions of an ordered and planned, but not duplicated, real, *produce a universe of images that dresses and masks the world without adhering to it* (II, 27, own translation, own italics).

This implies, in his terms, that contemporary cultures are subjected to become a substitute for reality: "cultural forms are detached from real life like a double that masks it" (II, 27, own translation). When models (or simulacra) acquire a force equivalent to reality, they not only have the dangerous capacity to distort it but also to occupy their very place [67] [68]. The forgotten and encyclopedic Mortimer Taube in his book "Computers and Common Sense" (1961) examined: "the proper man-machine relation is one of complementation and

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[66] This discussion has also been addressed in the early section: "AI between simulacrum and metaphysics" (Sect. Chapter I, §1., 1.2.).

[67] The great recipient of modern life, Jean Baudrillard, regards Borges' cartography (the one that initiated and guided our first lines) as "useless" (although Borges himself already expressed it in that very tale). According to Baudrillard *reality fits into the simulation model*, dissolving all distinction between the real and their signs.
The exhaustive analysis of his claim is not relevant here, however, it becomes relevant to succinctly restate its central thesis: "hyperreality" whose concept evokes the synthesis, indistinction, and dissuasion between the model and the real. Baudrillard's thesis, of course, is consistent with the postmodern epistemic logic of representation as that which occupies a false place, of *simulatio* but does not contain that *motus animi continuus* of the real. Although the author did not mention them, computational simulations are a legitimate analogy to doubtlessly occupy the place of simulacra.

[68] In a critical and fully accurate tone, Sherry Turkle argues:

> The reality of simulation culture as it has developed, whether in games, professions, or politics (where simulations are central to planning) is that those who write the simulations get to set the parameters. [...]
> And increasingly, we stand on the boundary between worlds we understand through transparent algorithm and worlds we understand by manipulating opaque simulation. (2005, pp. 13-15).

augmentation, not simulation" (p. 68). Simondon himself condemned the simulacrum based on the example of the aesthetic object: "A educated man would never dare to speak of objects or figures painted on canvas as genuine realities" (MEOT, 16, 17).

The practice of simulation corresponds to the concept of the artificial as distinct or opposed to the natural. This is a major split in philosophical thought that Simondon has tried as early as 1958 to bridge. In that year, his thesis drew attention to the fact that, since the Renaissance, the evolutionary series of machines had failed to preserve the unity of technology. Thus giving rise to the split between *culture* and *technique*. The machine lost *technological universality,* namely, the machine lost its relation with the natural domain[69] *becoming* therefore *an artificial object.* To illustrate this, he pointed to the fact that at the end of the 18th century, agriculture and cattle breeding were no longer seen as part of the cultural sphere. The understanding of the machine as artificial[70], Simondon concluded, distances the human being from nature, from the world (MEOT, 79-81). To achieve integration, universality, and univocity, at least one condition shall be accomplished: the formalization of nature in the technological universe, namely, the fact that technical objects take the living organism as a model. While facing a milieu, technology shall achieve the resolution of a problem and, at the same time, universalize its applications.

> The more the techniques become objects, the more they tend to transfer nature into the created; the progressive evolution of the techniques, thanks to the amplifying surplus value of each invention that constitutes an object, transfers the natural effects into the world of the techniques, which results in the fact that the techniques, progressively, become naturalized (II, 196, own translation).

We rewrite this in the following terms, there is a tendency of hyperhistorical patterns to resemble patterns of ancestrality. Technology returns to abstraction, it aims for unity while

[69] Precisely the crux of *simulacra* leads technological evolution to the reproduction and manipulation of the objects of reality with a non-universal and artificial conception of technology. Heidegger did not refer to the essence of technology by addressing different hammers built for different uses, he regarded the hammer in a universal sense. Dreyfus underlined: "Once we see that technology is our latest understanding of being, we will be grateful for it" (2002, p. 29).

[70] Strengthening the artificial thesis, the simulacrum does not paradigmatically bring the human and the technological closer together; on the contrary, it alienates them. The simulacrum model does not include the most technological scheme of all: *nature*.

multiplying itself. Today's great machine learning theorist Ethem Alpaydin wrote: "The screen is a digital simulacrum" (2021, p. 4). The very thesis of the *simulacrum* shall not start from the assumption of occupying or replacing the real (as found in Baudrillard) but of establishing itself as a second order of reality, that is, borrowing an expression of *the poet of the machine*: "the shell of a universe in the interior of another universe" (II, 86, own translation).

When Simondon saw the genetic notion of individuation (individualization) as a gateway to a new essence of technology, he saw the key to instill itself in our political-cultural reading. With individuation not only an ontological-methodological reading can be done but also a *cultural-political operation*. We can now regard individuation as the operation of being that becomes political when it is applied as an operation of differentiation and rupture with regard to fixed patterns. Individuation is that which allows the creative dynamics of differentiation, that which tends to develop the potentialities of the particular, of the *singulatim*. This is necessary to understand, in order to account along the next chapter for how a pattern-based culture may respond to an opposing force, to a growing loss of individuation, where the particular is dissolved into the general pattern, into the uni-*form*.

Part III

Automated patterns of culture:

The political-cultural axiom

The gods have not died

what has died is our ability to see them

Fernando Pessoa, *The return of the gods*

CHAPTER VII

Towards des-individuation

§1. The project of ecumenical culture

At the core of modernity (based on rational calculation) is the loss of the original language (*Ursprache*): the myth (Hölderlin), the death of the gods (Heidegger), the disenchantment of the world (Weber), the deconstruction of metaphysics (Badiou), the displacement of sense (Hörl), the very loss of the *kosmos (κόσμος)*.

With the loss of the magical element (mythical-sacred) in culture, arose the project of bringing human knowledge to perfection through the indefinite progress announced by arts, sciences and inventions[1] aided by new instruments. Since modernity (ca. 17th century), it has been profoundly installed the idea that by relying on modern scientific methods refined by technological developments we are heading towards the "enlightenment" (*Aufklärung*) and, on

[1] Around 1620, the three works (the last being unfinished) of Francis Bacon: *De dignitate, Novum organum, Instauratio,* pursued this ambitious project, thus trying to reconstruct the (ancient) sciences with respect to the emerging ones. For a critique to this project: Cf.,(Vico, 2018 [c. 1708]]). See also, McRae, R. (2020).

the contrary, pre-modern knowledge shall rather be pushed into the "obscurity" where "magical thinking"[2] [3] holds sway.

The "empirical attitude" thus placed all elements of reality under the "light" (or "artificial light", as expressed by Whitehead) and standardization of the scientific method. This reveals that everything that would not fit under the conventional parameters (mainly quantitative and rationalistic) would be condemned to oblivion, and knowledge, as a consequence of this, would be reduced to production and, even more to our times, to customization[4]. As Heidegger himself warned, most importantly, the question on *being* itself would fit within that oblivion (*Seinsvergessenheit*). Along with this dark gear, the expressly platonic relationship between metaphysics and mathematics (and not between mathematics and language) has slowly bled itself dry[5]. Along different ancient civilizations (such as, the Sanskrit, the Egyptian, and the Chinese) mathematics was a highly esoteric enterprise as Restivo

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[2] The concept of "magic" initially means *the union of the divine with the earthly.* The concept has been elaborated through different expressions of millenary cultures and has fallen into discredit today. Although each sacred element differs in every period and culture and whose debate is too long to enter into detail here, pre-modern visions, far from being based merely on what contemptuously is called "magical thinking", applied their holistic (metaphysic) cosmovisions also guided by logic-mathematical thinking: concrete mathematical (geometrical) objects (by Greeks) and logical studies, Liberal Arts, (by medievals). Particularly for the latter, holistic cosmovisions aimed to apply the use of reason to their cosmovision, manifested in God, so that reason does not become separated, in the Aristotelian sense, from the "common good". This is widely worked by authors such as: Anselm of Aosta, Thomas Aquinas and Meister Eckhart. Also by using non-alphabetic recording systems such as: Sumerian cuneiform, Mayan hieroglyphs, Ican khipu, one can also notice that ancient or pre-modern cultures had great precision of astronomical regularities. Cf., Saez-Rodríguez, A. (2012).

[3] In the medieval tradition "magic" has nothing to do with the association of "superstition" as it is nowadays simplified. Seb Falk indicates that magic was a complex category that had, at least, two clear meanings: one in relation to nature and its properties known as "natural magic", in which a great part of its observations could be found in medicinal plants for care and healing as well as in alchemy, the study of minerals, and others. The second meaning has been referred by him as "image magic": "were practitioners [...] used objects - talismans or images- to harness the power of the cosmos" (Falk, 2020, p. 198).

[4] Cf., Galloway, 2014.

[5] Much later this problem still remains (or even more, increases):

> The cost of this was the destitution of ontology itself: either in the shape given to it by Wittgenstein, namely, statements of ontology are non-sense; or in the version Heidegger gives to it, namely, statements of metaphysics are in the epoch of their nihilistic closure (Badiou, 2006, p. 110).

explains: "Writing and mathematics were highly esoteric skills in the ancient civilizations when they were first developed. Those who possessed these skills were almost exclusively state or religious dignitaries" (1992, p. 33).

In the pre-modern cosmovisions, *scientia* did not imply, like it is the case nowadays, the application of methods universally accepted within the scientific community (whether these norms and values are enduring or not). As the historian of medieval mathematical sciences, Seb Falk, explains: "Scientific - if not overly complex - content was blended with traditional wisdom and put to poetic purposes" (2020, p. 24). Accordingly, as regards the Middle Ages[6], mathematicians, physicians, and astronomers could also be considered poets, philosophers, theologians or monks. That particular *scientia* entailed the study of interrelated [7] [8] fields of knowledge sharing a *summum bonus:* the vastness of the One, namely, the *uni-versus* (*uni* meaning *one* and *versus* meaning *turned*, i.e., "turned into one").

The mathematical-astronomical studies of the universe's workings were not merely methodological, they were part of a bigger picture of God's mind[9]: *Cum Deus calculat, fit*

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[6] As Erich Fromm pointed out in his book, *Escape from Freedom* (1941), the "Middle Ages" as such is an ideal type, as is its counterpart "Capitalist Society". It is, therefore, necessary to take into account that one period does not end or the other begins, but that elements of both one and the other exist, overlap, and continuously develop. That is to say, as the author described, that there are elements, capitalist economic forces already developed in the Middle Ages as well as medieval elements that still exist in the current capitalist society (Fromm, 1941, p. 40). It is interesting to realize that a fruitful analysis may be pursued behind the conception that *there are elements of medieval culture,* for example, that of belonging to a category, *which began to be recovered today*. In his study of medieval culture Jacob Burckhardt expressed: "Man was conscious of himself only as member of a race, people, party, family, or corporation - only through some general category" (Burckhardt, 1921, p. 129 in Fromm, 1941, p. 43).

[7] The very word "algorithm" was first copied in its medieval Latin translation (*algorismus*) within a monastery in England coming from the European adaptation of a new numeral system from a treatise in Arabic written by Muhammad ibn Musa al-Khwarizmi. Cf., Falk (2020, p. 32). See also, Crossley, J. N. (2013).

[8] Falk described the interrelation between mathematics and the cosmos:

> [...] the contemplation of the stars gave meaning to the vast cosmos; a glimpse into the mind of God. Measurement and mathematical analysis could only heighten [a monk's] sense of a world that was precisely designed and obedient to God's laws (Falk, 2020, p. 42, own brackets with addition).

[9] With great clarity, Sal Restivo described this idea in the following way:

mundus. In this sense, the medieval God did not simply responded, as it is usually simplified, to an anthropomorphized effector cause (creator), but slightly more, to a bound between the divine and the earthly, heaven and mud, this is why agriculture was so connected to astronomy, farmers had to read the heavens in order to cultivate the land (Falk, 2020, p. 19).

> Mathematical work in the seventeenth, eighteenth, and nineteenth centuries was explicitly experienced by practitioners as a revelation of the works of God the mathematician. Spengler, of course, claimed that mathematical innovators tend to be either religious leaders or people who experience mathematics as a religion (Restivo, 1992, p. 95).

For both, middle-ages pagans and christians, science rested on metaphysics (i.e., "above nature") and its very project was to create a path of spiritual and moral enrichment, a bigger picture of life recognized by one of the first modern scientists and last metaphysicians, Isaac Newton, under the name of "natural philosophy" (Falk, 2020). A series of fundamental events, together with the *philosophia naturalis,* were crucial for the techno-scientific formation of the early modern period: the beginning of symbolic thinking in mathematics (algebraic representations by Descartes and Leibniz), of modern mechanics (Galilei and Newton), of materialistic ideas (Hobbes), the turn from deductive to experimental method (Bacon), the new trajectory of celestial bodies (Copernicus), and the human being, now deprived from nature, as an ontological unity of meaning (the beginning of humanism).

In pre-modernity, specially in the Middle ages, in a vain an attempt to harmonize greek and christian lines of thoughts (Del Noce, 2014), culture was manifested through sacred expressions, this supposed, the symbolic repetition of *acts of creation*, as analyzed by Mircea Eliade when referring to patterns (eternal return) and archetypes (Eliade, 1994, p. 22). Therefore, the un–cultured, the opposite sign to culture, was manifested through the acts of *chaos*, the *formless*, that which bears no differentiated pattern. The dimension of culture had a *kosmos*, order, precision, harmony, hierarchy, and patterns of behavior set by tradition, while the uncultured dimension of culture had no harmony of form, no order, but growing void. Let

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In medieval Europe theological discussions of infinity were an important part of the history of calculus. More generally Nicolas of Cusa (in, *Amor Dei Intellectualis*) found true love of God in mathematics; he defended an intellectual art that reveals the Divine in mathematics. And Norvalis (Friedrich von Hardenberg, D. 1801) considered mathematics to be a religion (Restivo, 1992, p. 94).

us remember, by means of Cassirer's profound studies of culture, in the *Logic of cultural sciences* (2000 [c. 1991]), that the defeat of shapeless chaos by the unified victory of cosmic and civil order can be traced in the early mythical creations coming from the Gilgamesh epic, the Vedas, the Egyptians, the Babylonians, and others (Cassirer, 2000, p. 2).

The object of culture, *ab origine*, was a supra-terrestrial, a cosmic object (their rivers, food, temples, their maps «like the Babilonian map of the world[10]», and also their patterns[11] are some of these objects of sacred experience). This idea was partially inherited in the early modern period, namely, the practice of *repeating creation* (making grow) around a sacred object (meal) which is why culture originally meant "the cultivation of the land", the exercise of *cultivating* and making the sacred *grow*. In the course of modernity, this association of culture with the act of cultivating the land was no longer considered in a sacred sense or as *colonus* (settled land) but instead as cultivation (*colere*) of the spirit through the use of reason. A cultivated practice was a practice of *otium*, namely, of leisure time however constituting a discipline (a *mélétè*): "This practice of *otium* is what, since the sixteenth century, is called [...] *culture*, as the «development of the intellectual faculties through appropriate exercises»" (Stiegler, 2011, p. 100). Thus, the modern object of culture was an object constructed by the rational faculties that characterized only the human and no longer the divine enterprise.

This project, formally led by the revolutionary bourgeoisie, was of a universal kind, that is, valid in all nations, epochs, and cultures, and therefore, it advocated universal values, such as: liberty, equality and fraternity (Sebreli, 2013, pp. 25-26). By 1784, Kant had already proposed the idea of universal peace and a society of nations in his work *Idee zu einer allgemeinen Geschichte in weltbürgerlicher Absicht* and in *Zum ewigen Frieden* (1795) also, from a different perspective, Hegel in *Philosophie des Rechts* of 1820 called for the various cultures and their distinctiveness (particularism) to submit into the rational process of *Weltgeist* (p. 26). Rationalism and universalism were the reverse of irrationality and particularism later expressed by some pre-romantics, romanticism or anti-enlightenment movements[12]. What lies

[10] For example, the Babylonian map of the world (8th or 7th BC) also known as *Imago Mundi* is surrounded by a circular ocean (*maratum*), this is, the Sumerian representation of the paradise (Eliade, 1994, p. 22).

[11] An extension of this idea is to be found in the Chapter called "Patterns of ancestrality": (Sect., Prolegomenon, Chapter II, § 1.).

[12] This is noticed by the Argentinian sociologist and philosopher, Juan José Sebreli, where in his book, *El asedio a la modernidad*, he writes:

behind romanticism?, the contemporary philosopher, Byung-Chul Han, answers, “Romanticism is horror at everything average and normal” (2017, p. 74). Romanticism could even be read today as the fear of a *statistical and average* type of *culture.*

Behind universalism, in parallel, the emerging sovereign nation-state held the power or monopoly of decision (Schmitt, 1922). Human behavior was no longer at the disposal of a sacred belief system but rather at the disposal of whoever controlled the means of power. Much later, Max Weber recognized that the monopoly of legitimate violence (power) was represented by the sovereign state itself. When knowledge began to be framed on secular and empirical thought driven by new techniques and methodologies[13], the political form of sovereign states began to take place. The force of sovereign states inaugurating the Peace of Westphalia in 1648 marked the beginning of secularization, nationalism, and also the *social realm*[14] in the European continent. The emergence of the State entailed the emergence of nationalism, supra-local political schemes, which tended to the unity and integration under common ideals or values. Bauman wrote about this interdependence: “There was a close, though elective, affinity between the modern effort to secure supra-local integration through state-managed legal order and the entrenchment of supra-local, national culture” (2000, p. xxxiv).

In the light of the new world that emerged after the armed religious and territorial conflicts (such as, the well-known Thirty Years’ War), *culture* began to lose the unifying

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> Thus, from the end of the eighteenth century onwards, an anti-Enlightenment current developed in parallel. This anti-Enlightenment had its expression in France in the form of the counter-revolutionaries de Joseph de Maistre and Louis de Bonald, in England with the pre-Romantic Edmund Burke and in Germany with the pre-Romantics Johann Gottfried Herder and Justus Möser, and subsequently in the Romantics. [...]
>
> The anti-Enlightenment Romantics opposed universalism national, ethnic and cultural particularities; to abstract reason, emotion; to progress, tradition; to the social contract, the family; to society, the community. Enlightenment sought all that men have in common, while anti-Enlightenment romanticism emphasized all that is different: nationality, race, religion (2013, pp. 26, 27 own translation).

[13] The first mechanical calculators took place under the name of *Rechen Uhr*/calculating clock by Wilhelm Schickard (1628) and the Pascaline/arithmetic machine by Pascal (1642). However, it is the forceful inventions in terms of energy transmission of the 19th century from Faraday with his Electric Dynamo (1831) onwards that will bring about the most profound reforms towards modern society.

[14] According to Hannah Arendt the new phenomenon of the “social realm” was not born until the modern nation-state age and had no relation with the previous idea of the social, coming from Greek origins, as the “alliance between people for a specific purpose” (1998, pp. 23-28).

(magical) force offered by wisdom and spiritual formation and began to become identified as a *powerful tool able to modify behavior* handled by the sovereign power. In other words, culture was no longer "hierophanic" (*hieros*, sacred and *phainein*, to manifest, to reveal), it rather became, following Blanchot in his analysis of civilization and culture the "general universal model toward which all societies at the time appear to be tending" (2021 [c. 1941], p. 55). Hence, culture became that "mirror of the boundless perfection" that is to say, of indefinite progress (p. 55).

Although *scientia,* as we noted, already existed in the Middle Ages[15], in modern times, it became completely independent of *sacrality*. Culture was therefore emptied of sacred meaning and thus transformed into an autonomous order at the discretion of (enlightened) reason: "the autonomy obtained by frequently engaging with rational knowledge, was for the *Aufklärer* the *sine qua non* of such a sovereignty" (Stiegler, 2015, p. 2). When culture lost its metaphysical-sacred character, it confirmed the end of its role as major regulator and became regulated by, on the one side, the increasingly imposing force of the techno-scientific aspect (based on empirical and experimental evidence) and, on the other side, the growing economic-mercantile aspect (based on the increment of profits)[16].

Behind these variables (technological progress and economic profit) something radically different from medieval culture came into being, that is, the individual economic initiative, the growth of competition, which later gave rise to the notion of the *individual* beyond a category belonging to a group, class or tradition[17], that is to say, the awareness of the

[15]Cf., Falk (2020).

[16] This has side effects. Between technical sophistication and economic optimization (effectiveness, efficiency, competitiveness), technology became increasingly reduced to cost-benefit efficiency. The link with technical objects thus became, as described by Simondon in MEOT, a bond of servitude reproduced in the machine which, in fact, represents the asymmetrical structures already inscribed in society itself.

[17] The same idea can be found in another source influenced by Fromm's conception of the individual not as separated entities but in terms of relationships. Pre-modernity associated the individual not by itself but as belonging to a group (see also footnote 6). Towards the modern period it is when the individual begins to be recognized outside the group. Raymond Williams analyzed:

> And this change, so far as we can now trace it in the imperfectly recorded history of the word itself, seems to have taken place in England in the late sixteenth and early seventeenth centuries. Slowly, and with many ambiguities, since that time, we have learned to think of the individual in his own right (Williams, 1961, pp. 73-74).

individual as a separate entity (Fromm, 1941, pp. 42-49). Although we do no wish to lengthy expand on this, since it is not the aim here to historically describe the development of the concept of culture, it is important to note that the last two variables already mentioned together will give rise much later in the 19th century and then deepened in the 20th to the *culturalization*[18] (Baudrillard, 1998) or the *cultural becoming* (Stiegler, 2014 [c. 2006]) of the productive system itself.

As different from the Fordist model of production[19], characterized by the organization and rationalization of serial work proceeding in a mechanized, fragmented and repetitive way, the post-Fordist model, in the second half of the 20th century, gave all access to the deepest layer of consumption: it was no longer based on undifferentiated and mechanical production of use-value of goods and services at mass-scale but on personalization[20], aestheticization, and differentiation at mass-consumption scale. According to different authors starting with Baudrillard (1993) to Naomi Klein (2002 [c. 2000]), such a system is based on the production and manipulation of signs, namely, of social signifiers: "an order of consumption, which is an order of the manipulation of signs" (Baudrillard, 1998, pp. 33, 60) aided by new technologies. "You never consume the object in itself (in its use-value); you are always manipulating objects (in the broadest sense) as signs" (1998, p. 61). The production and manipulation of signs by the individual consumer introduces, in return, *the unconscious collective structure around consumption*. The consumer society described by Baudrillard is characterized not primarily by production but by the order and manipulation of signs for consumption. For example, there is not a consumable object for sale, what is consumed is an abstraction, such as Happiness, Growth, Abundance. In other words, consumption is morphed by emotions (managed by desire) whose drive pertains to a *libidinal economy* (this is Freud's re-orientation by Lyotard, 1974).

In addition to this, as Baudrillard pointed out, the higher the level of density and concentration of people in industrial and urban societies, the demand for differentiation grows

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[18] Baudrillard used the concept of *culturalization* to point out the strongly symbolic nature of the objects for consumption. When referring to the place of consumption-gathering, the shopping center or drugstore, he expressed: "It would be simplistic to say that culture is «prostituted» there. It is culturalized. Simultaneously, commodities (clothing, groceries, catering, etc.) are also culturalized in their turn, since they are transformed into the substance of play and distinction" (1998, pp. 27-28).

[19] Stiegler identified this Fordist and welfare state model with the second spirit of capitalism, after the first spirit described in the Protestant ethic by Weber. Cf., (Stiegler, 2014).

[20] This level of exacerbated personalization declines towards the very contemporary psycho-social problem of narcissism (see footnote 35).

more than material production (1998, pp. 64-65). Thus *culture becomes a pattern-producing machine*, the tendency of patterns of behavior associated with products shall now become part of a *higher model* and offer to the individual the illusion of affiliation or distinction with respect to some other general category. Initially, this latter post-war order of consumption gave rise to the so-called *mass society* which rapidly converted into a *consumer society*, and therefore, the greatest *threat* to culture[21], as it had been greatly studied not only by ideology-drived marxist studies but also by Leavis in *Mass Civilisation and Minority Culture* (1930).

Although the concept of "mass" is not generally discouraged by culture theorists, society understood as a "mass" is not a cultural concept to which all theorists adhere, one of the considered fathers of the field of cultural studies and one of the few who dealt with the concept of *pattern*, Raymond Williams, argued that: "There are in fact no masses, there are only ways of seeing people as masses" (Williams, 1961 in Tudor, 1999, p. 41). In 1961, Williams called attention to the *cultural analysis of patterns and their relations*, influenced by Ruth Benedict's anthropological study of cultural patterns in 1934 and Erich Fromm's social characteristics (Tudor, 1999, p. 42)[22]. The masses or large statistical samples get access to patterns by means of representative models or models *to follow.* It is the model that describes the dynamics of the pattern. It is fairly no wonder that our so-called *hyperculture* (Han, 2022) is highly characterized by "following" models (*influencers*) within social networking platforms. That is, the pattern expressed by the model is an underlying expression, borrowing the poetic license of Shelley, of "the image of all other minds" (Shelley in Williams, 1961, p. 10).

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[21] One of the roots of this ever-lasting problem remains in the fact that its cultural mechanisms and cultural forms are no longer necessarily based on values or traditions but mostly on nihilism, hedonism, and value-relativism. Effects upon which the current cultural decline of hyperindustry is still being nourished (Stiegler, 2011, 2013, 2014) (Sect., Part III, Chapter VIII, § 2., 2.2., 2.3.).

[22] Notably he expressed this in the following way:

> [W]e can even recover what Fromm calls the «social character» or Benedict the «pattern of culture». The social character—a valued system of behaviour and attitudes—is taught, formally and informally; it is both an ideal and a mode. The «pattern of culture» is a selection and configuration of interests and activities, and a particular valuation of them, producing a distinct organization, a «way of life». Yet even these, as we recover them, are usually abstract. Possibly, however, we can gain the sense of a further common element, which is neither the character nor the pattern, but as it were the actual experience through which these were lived [...] The term I would suggest to describe it is structure of feeling (Williams, 1961, pp. 47, 48)

Models to be *followed* are not a trend, a mode, but an abstraction. Abstraction is the critical node by means of which Williams attempted to replace "patterns of culture" with "structure of feelings" (see footnote 22). We employed the term "attempt" because what he actually did is to replace one abstraction with another. *Patterns,* according to his critique, lack the distinctive experiential dimension of social character where real lives occur while the *structure of feeling* can be best associated with actual experience (Tudor, 1999, p. 43): "[T]his structure of feeling is the culture of a period: it is the particular living result of all the elements in the general organization" (1961, p. 48). As we shall see later, the patterns represented in models themselves are not only abstract manifestations that guide behavior but, as we have seen in the first part when analyzing Simondon (Sect., Part I, Chapter IV, §1.), they also fulfill an archetypal function.

The automation of culture is dropping the veil of collective archetypes, collective models while revealing which patterns operate in the collective unconscious of the individual as oriented-consumer. Machine learning technology and its profiling techniques (*user profiling*), which, in the world of business intelligence, is not referred as to the ability to "access behavioral control" but rather to "leverage behavioral insights", has became what we would like to call *technologies of the unconscious* capable of revealing sensitive patterns operating at the psycho-social level (Sect., Part III, Chapter VIII, § 1., 1.1). When referring to *user profiling,* Stiegler explained: "[It] consists in identifying your search behavior in order to propose something to you before you even have the idea of asking for it. If this is not a programming of consciousness, it is conditioning and reinforcement, in the Pavlovian sense of these terms" (2009, p. 76).

Tracing back again to the structure of the previous arguments, consumer society means that consumption itself becomes the very foundation of our entire cultural system (Mayer, 1998, p. ix). In the late 14th century, the Latin expression *consumere* already implied, by its etymological sense, to "destroy the substance of", as the opposite of production. That is to say, to consume was linked to "annihilate" something created, similar to what we already described regarding pre-modernity the un-cultured (producer of chaos) against the dimension of culture (producer of harmony and form). The increasing society of consumption and the "proletarianization of consumers" as liquidation of *savoir-vivre* (Stiegler, 2014, p. 71) implies the death of the *kosmos,* the *consumere* of the *kosmos,* the rise of nihilism while culminating a series of events that describe the current post-modern times: not only the end of the mythical-sacred element but, above all, the end of the rational-secularized elements in culture, and the opposite also occurs: the grow of the irrational desire-drive relations. This decomposition burdens the objects of culture with signs (as formulated by Baudrillard) while removing from them their true symbolic force. Indeed, the consumer society suffers from what Stiegler labeled as symbolic misery: "Symbolic misery leads irresistibly to spiritual misery"[23] (Stiegler, 2013, p. 2).

In the second half of the 20th century, Simondon analyzed thoroughly that the real cultural project consisted in reintroducing again the sacred (sacredness[24]) but also, introducing for the very first time technology (technicity) in the field of culture: "today, technicity […] can become a foundation for culture, to which it will bring a unifying and stabilizing power, making culture adequate to the reality which it expresses and regulates" (MEOT, 21). Simondon continued to develop this idea a few years later in *Psychosociologie de la technicité:*

> No indication has been found [...] that technicity cannot constitute, like sacredness, the foundation of culture. Certainly there is no identity between technicity and sacredness, but it could happen that the structure of technicity and the structure of sacredness are isomorphic" (PST, 31, own translation).

Although we have employed and clarified the concept in Part I, what does technicity precisely mean[25]? Heredia and Rodriguez explain with great precision:

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[23] Also see his book on symbolic misery in Stiegler (2014).

[24] The sacredness is concretized through religion or religious consciousness. For Simondon, religious consciousness must undoubtedly be a central part of the cultural program and the educational program. At the beginning of his research, he remarked this in an original manuscript that has been integrated in the article *Prolégomènes à une refonte de l'enseignement:*

> Religious consciousness, if it is truly religious, allows the learning of the transindividual; if it is incorporated into a social myth, it is a source of alienation and develops irrepressible inhibitions. It is necessary, then, to fight against religious separatism, against the submission of religious forces to past social structures, and return religious forces to transindividual ethics. There must be an education in the history of religions and morals according to the different religions present in a nation (PRE, 241, own translation).

[25] This concept has been also worked on in Part I. Simondon defined *technicity* as follows:

> The technicity that manifests itself in the use of objects can perhaps be conceived as appearing in a structuration that provisionally resolves the problems posed by the primitive and the original phase of man's relationship to the world [...]

> Technics becomes provocative and instrumental when it is enclosed in the paradigm of work and domination; when it steps out of it, it comes to be called technicity. But technicity [...] appeals to sacredness. Both technicity and sacredness aspire to a generalization: one as reticularization, the other as totalization (2017, p. 18, own translation).

Technicity, as well as sacredness, constitute the foundational phases of the whole of reality, according to Simondon's genetic metaphysical scheme elaborated in the third part of MEOT. When *being*, a magical-primitive, pre-technical, and pre-religious unity, splits in two[26] it produces a *rupture,* a *phase-shift* within itself. From this event, the figure (technicity) and the background (sacredness) are born. Technicity and sacredness mediate reality between the human being and the world. Behind the figures, technicity operates, and behind the background, it is sacredness what is operating as a whole (MEOT, 169-171). Barthélémy explains: "The function of such a neutral point [*the phase-shift*] is to recall, of course in an imperfect way, this lost unity of the «being in the world» of the human being" (2012, p. 206, own bracketing with addition).

Neither technicity should prescind from sacredness, nor sacredness should prescind from technicity, recognized the French philosopher: "the degradation of technicity parallels the degradation of sacredness" (ST, 80, own translation). Degrading one in the name of the other

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> Technicity [...] is also the depositary of a capacity to evolve, precisely because, as solution to a first problem, it has the capacity to be a mediation between man and the world (MEOT, 169, 170).

In *Psychosociologie de la technicité* (1960-1961)*,* he offered another definition of technicity:

> Technicity is a mode of being that cannot exist fully and permanently but in a network, both temporally and spatially. [...] Spatial reticulation consists in the fact that technicity cannot be contained in a single object. [...] Technicity is a characteristic of the functional whole that covers the world and in which the object acquires significance; it plays a role together with other objects (PST, 82, own translation).

[26] Why is there *splitting*/ *rupture* at all?. Following Simondon, the initial system, like every system with an active becoming, contains a state of tension, of incompatibility with itself, of oversaturation that enables it to transform and restructure itself at the same time.

destroys the postulate of reticulation and totalization between technics and the sacred, in which technics pluralizes or multiplies and the sacred, integrates, reunites (MEOT, pp. 223-246). What Simondon saw in the *technical object* is culture itself expressing its own mechanisms of technicity and sacrality, regulations, controls, and also automatisms, thus, technicity is a deeper layer of cultural servo-mechanisms. By doing so, he meant to recreate an "ecumenical culture", that is to say: "to restore to culture the truly general character it has lost" (MEOT, 19).

One of Simondon's first public appearances was in a 1953 lecture where the young man enthusiastically rescued the superior character of culture in its *universal and essentialist* aspect beyond its local particularities and beyond its *hic et nunc*. Optimistically he explained: "We cannot forget that the Renaissance humanists not only had the ideal of enthroning culture, but also of repelling the forces of obscurity[27]" (HCNN, 74, own translation). Despite the fact that five years later, he made a strong criticism of contemporary humanism[28] for giving place to the opposition between the human and the machine, culture and technics, he recognized that behind the humanist project there was the great purpose of incarnating meaning (*sens*) in human existence based on its cultural expressions. The opposite to this, was to reduce cultural expressions to absurdity, something that, for example, (as remarked by Simondon himself) existentialism had managed to do, thus, eliminating any purpose (*télos*) in human existence.

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[27] To such obscurity (*humanisme négatif*) participate, according to Simondon, existentialism and communism, among others. Visions that shorten the cultural horizon into dogmatic and despotic positions. Moreover, for Simondon, Sartre, as a fundamental figure of existentialism, rather satisfies the writer's art (*l'art de l'écrivain*) than the attack on the crucial contemporary psychological and philosophical problems (Simondon & Le Terrier, 1957, p. 1678, own translation).

[28] We distinguish between ancient humanism and contemporary humanism. While Simondon criticizes the latter, he offers, on the other hand, a pro-antique humanism discourse, as he wrote in *Note sur l'objet technique*:

> Ancient humanism was, in a broad sense, an extensive, well assimilated, varied and rich culture. In a precise sense, it was the practice of humanity, that is to say, of that generous and penetrating attention by which the free man, overcoming the social distinctions of master and slave, recognizes the slave as human and wants to make of him a being who thinks, who feels , and who desires (PRE, 253, own translation).

In MEOT, Simondon considered an open definition of humanism according to its proper time: "each epoch must discover its humanism, by orienting itself toward the main danger of alienation" (MEOT, 118). Hörl refers to Simondon's program as a technological humanism *(technologischer Humanismus)* (2017, p. 243) which is capable of relocating in a new sense the human being in the collective of technical networks. Hence, Hörl himself calls his program: *spekulative allgemeine Ökologie* (general speculative ecology).

With the emergence of what Simondon called *technical culture* he demanded that not only culture but also technology be made truly universal[29]: "technology must deal with the universality of technical objects" (MEOT, 51). Although both play the role of regulators of information and communication, if technology becomes the foundation of culture, it can give culture itself the unity and stability that it has lost, thus allowing culture to regulate the reality that it expresses (MEOT, 21).

At first glance, it would appear unnecessary to make such distinctions. This is mostly due to the fact that all cultural objects became mediated, transmitted, reproduced and selected by digital technology itself (the prevailing type of technology). Yet, to all appearances, culture became regulated by technology but not the other way around (see, the next section, Sect., 1.1.). With the new digital mechanisms for the transmission, preservation and regulation of cultural content, there is a current profound disorientation, an *Ent-ortung*: a general delocalization, a nonplussed culture with its emerging patterns.

1.1. The behavioral orchestration behind artificial intelligence: *technologies of the unconscious*

Once that the metaphysical or sacred soil has been exhausted, where culture used to be bound to the land as well as to tradition (a cosmo-vision), a "phase-shift" towards new paths undertakes the task of reproducing new cultural objects. Fundamentally, these are objects of consumerism not associated with the land or with tradition. These new objects of culture rather adopt the behavior of a virus: cultural contents spread and replicate infinitely everywhere, penetrating all layers of society and modifying (but mostly disorienting) public opinion[30]. Daniel Dennett (2018) is the philosopher who recognized this phenomenon of what we can refer as "cultural viruses" or as Weiser and Alam called a "meme culture" (2022). Cultural objects (such as a word, images, videos, any digital content) in terms of "memes" are culturally transmitted agents evolving by random selection:

[29] It is possible that, to a great extent, Simondon rescued the idea of the unity of culture from his reading of a 1952 article by Georges Zadou-Naïsky: *Unité de la culture et spécialisation des études.* Cf., *Prolégomènes à une refonte de l'enseignement* (1954).

[30] Stiegler made an interesting observation regarding opinion as similar to the fire, to his eyes, opinion can: "heat the house or burn it down, and beyond the house, the city itself [...] we must take care of it" (2014, p. 89).

> A word, like a virus, is a minimal kind of *agent*: it *wants to get itself said* (Dennett, 1991, pp. 227-252). Why? Because if it doesn't, it will soon go extinct. [...].
> An informational thing doesn't have a mind, of course, any more than a virus does, but, like a virus, it is designed (by evolution, mainly) to provoke and enhance its own replication, and *every token it generates is one of its offspring* (Dennett, 2017, p. 189).

Cultural viruses (any digital item or platform with the power to propagate messages/ideas) do not seem to be a regulating aspect of culture, but rather, they use culture as their own means in order to continue propagating and replicating themselves. In societies driven by mechanisms able to destroy their own institutional systems, traditions, and identities, the immediate spread of a well-propagated tiny "cultural virus" bears the force to distort everything. When it comes to digital culture, with its memetic reproduction, cultural objects or cultural milieus seem to be everywhere while being nowhere at the same time. Although it seems that every object or relations can become a *cultural milieu* just because they are part of the interrelationships at play in digital mediation, this might be a trap. If, as practiced today, everything is a cultural object, then culture as such has ceased to exist. Culture thus loses its capacity to be localized, to have a purpose for bringing its manifestations to light (*télos*), and above all, it loses its capacity to be referred (named). On this problem of referentiality Blanchot wrote: "«Culture» and «civilization» are like passwords indicating paths that lead nowhere, or like «Open sesames» intoned before a roadblock" (2021, p. 54).

Where is the trap then? When something cannot be named, then, it cannot become a *conscious* fact either. This is how culture has been left stuck in the dark valley of the unconscious and precisely where attention-economy plays its best game for cultural viruses to reproduce rapidly (Sect., § 2. 2.2). The TikTok's slogan, "TikTok made me do it" is a way of revealing this deep attention-economy operative force at the unconscious level, the *general degrading of consciousness* or even, *regressive behavior* in Stiegler's terms (2013, pp. 66-70) in which subjects respond automatically to stimuli while devoid of self-will (again, "it made me do it", it is not a conscious fact).

Stiegler, whose studies are formerly based on Simondon's study, becomes today, a visionary leader in his reading of our contemporary state of the art: "The fundamental problem, and the crippling limit of this attention-control apparatus, is that it destroys attention itself" (Stiegler, 2010, p. 13). With the drawn of consciousness, the loss of affection surfaces (*disaffection*) as studied by Stiegler (2013 [c. 2011]), which is why the addictive reinforcement of these technologies implies, in many cases, an exponential increase of narcissism[31], and in many others, of self-devaluation. To understand the extent of digital technology driven by AI technology in culture we shall emphasize on this massive loss of consciousness as a welcoming into *psychopolitics*.

> Today, we are entering the age of digital psychopolitics. [...] As such, it is precipitating a further crisis of freedom; now, free will itself is at stake. [...] Biopolitics[32], which makes use of population statistics, has no access to the psychic realm. [...] On this score, statistics and Big Data lie worlds apart. Big Data provides the means for establishing not just an individual but a collective pyschogram - perhaps even the *psychogram of the unconscious itself.* As such, it may yet shine a light into the depths of the psyche and exploit the unconscious entirely (Han, 2017, p. 21).

The configurational and structuring attention-type and emotions-patterns[33] that prevail at the unconscious level (since its psychoanalytic origins in the early 20th century) are of two types: desire and fear. Precisely, these are the all-encompassing psychic energy, emotional

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[31] Preceding remarks about the appeal of public admiration as a reward for vanity are to be found in Adam Smith's *The Wealth of Nations* (1766), also Hannah Arendt's *The Human Condition* (1958). It was Erich Fromm (1941) who distinguished, very clearly, his position regarding the narcissist from that of Freud in the following way: "Freud has pointed out that the narcissistic person has withdrawn his love from others and turned it toward his own person. Although the first part of this statement is true, the second is a fallacy. He loves neither others nor himself" (1941, p. 116). That is to say, as Fromm explained, their narcissism represents an overcompassion to themselves because of this very lack of love in the greatest possible sense. Differently, Baudrillard (1998) analyzed it from the point of view of society exchange of signs: in the modern social system based on the exchange of signs (as already explained previously), the differentiated production of products *designed for* specific groups (personalization) brings with it a "*personalized* narcissism" or "*managed* narcissism": "It is by coming close to your reference ideal, by being «truly yourself», that you most fully obey the collective imperative and most closely coincide with a particular «imposed» model" (Baudrillard, pp. 95, 131).

[32] The passage from Foucault's biopower to Stiegler's psychopower can be found in the latter's work: Stiegler, B. . (2010).

[33] On the role and evolution of emotions on cognitive processes from a biological point of view: Cf., Adolphs, R., & Anderson, D. (2018). Differently, on pioneering the study of emotions in machines (affective computing): Cf., Picard, R. W. (1997).

structures that Simondon referred in *Cours sur l'instinct*, in terms of "configurational nature (*patterns*)" (CI, 253)[34]. Despite the fact that these configurational emotional-patterns are linked to primitive (instinctive) cognitive instances, they are necessary and primary engines for a further development of a more complex cognitive behavior. This means that so much fear as well as desire constitute and dominate the foundational basis of most of human behavior. Already in modernity, Spinoza distinguished between absolute thought (*cogitatio*), as an attribute of God, from the intellect (*intellectus*) and this from other ways of knowing such as "love, desire, etc" (Badiou, 2006, p. 77). There is a high level of *correspondence between automatism and desire* that Simondon managed to understand when considering the automatism of the technical object and the desire developed in the psychosocial structures:

> An object is modern by the response it gives to paleopsychic forms of desire, and the real content of the quality of modernity is made of archaic schemes of thought. Automatism, which permanently haunts the spirit of the defenders of culture, has been put into technical objects by the human feeling of anxiety, by the fear of failure and danger (PST, 77, own translation).

Automatism does not belong to the technical object, as believed precipitously. Automatism has psychosocial origins whose concretization is displaced to the technical object itself. Now, when culture is left in the dark valley of unconsciousness, their objects (all types of cultural manifestations) are constantly associated with the *affective-emotive* mechanisms. These mechanisms reinforce over and over the psychosocial link between, on the one side, attention provoking desire and fear of individuals with, on the other side, the cultural contents themselves. The *quid proprium* of this matter consists in that, we have arrived at a time when, if the cultural object by means of its digital milieu does not *provoke desire or activates fear*, and any other subvariant of these configurational-patterns, it is not worthy of *attention*. Thanks to these psycho-social mechanisms that function as a common background in culture, we have, without questioning it, opened the door to a so-called "attention economy" where business-models increment their revenue streams at the cost of destroying attention. These cultural, cognitive technologies or cultural industrialization has been referred by Stiegler and his

[34] We had already explained this in: Sect., Part I, Chapter IV, §1: *The concept of pattern in Simondon.*

colleagues at Ars Industrialis as "technologies of spirit"[35]. In alignment with Simondon's previous citation and with the welcoming to psychopolitics, Stiegler explained:

> *[Un]controlled* cultural industrialization activates the psychopower of attentional control, which then constrains fantasy (having become "entertainment") to the role of capturing its audience through the most archaic drives, then compelling it to construct a consciousness reduced to simple, reflex cerebral functions, which is always disenchanted and always "available[36]" (2010, p. 15).

> Capturing attention destroys attention - and, with it, the quality of *being attentive* (which is social and not merely psychological) [...] technics has largely become an industrial system of cognitive and cultural technologies, that is, of what I and my colleagues at Ars Industrialis call technologies of spirit (2013, pp. 91, 93).

Stiegler later entitled this psychosocial event in terms of the *lack of attention or toxicomania as social model* which he, still looking to the past, attributed to television rather than to algorithmically highly sophisticated and coordinated digital technologies. Cognitive and psycho-technologies are cultural weapons ready to capture conscious-attention, able to produce what Baudelaire and Paul de Man called *dedoublement*, a split into *automated unconsciousness.* Culture has become the very battlefield for AI technologies, these are the very "weapons in a war for minds" (Stiegler, 2010, p. 33), namely, those *psychotechnologies*, *technologies of spirit* or, as we call it here, *technologies of the unconscious.*

The protagonism of the libidinal economy or the economy of desire has placed desire itself as the subject of a "destructive calculation" (Stiegler, 2013, p. 70). Unlike what Stiegler observed, desire is not destroyed through mathematical calculation performed by high performance computing, rather, the opposite may occur, desire can be also constructed. If technology allows transindividuation instead of desindividuation the tendency to be uni-formed tends to decrease. The former implies, finding itself in a dynamic process of individuation to

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[35] He wrote: "Today, attention control via cultural and cognitive technologies (technologies of the *spirit [espirit]*," those malignant spirits haunting the adult minor as apparatuses for capturing, forming, and deforming attention), has become the very heart of hyperindustrial society" (2010, p. 22).

[36] By available, Stiegler meant, "available brain time" at the disposal of and captured by industries and psychopower companies. Cf., Stiegler (2010, p. 38).

become, to trans-form, to differentiate. As Roberto Nigro noted in the context of a personal dialogue (2022): *mathematics can also be seen as resistance* and, we could add, not as an engine of destruction. Beyond these considerations, it is nonetheless essential to note that the networked technical system, as we know it today, automated by means of data-driven platforms, rather than putting in check the faculties that belong to the domain of reason, exposes and reactivates the obscure gears of the unconscious where the deep layers of emotional patterns hide. This is an entirely new event in 21st century *digital culture.*

Psychotechnologies can even suppose a crisis of values[37] [38] or as Stiegler called it the "decline of spirit value". While in pre-modern culture, sacred-systems or belief systems have been the unifying and stabilizing axis of common values shared in societies at large[39], and in the modern stage, it has been the secularized State (recognized *de jure*) and its corresponding legal-political codex, the regulating element of values in civil behaviors universally supplied by principles following the use of reason, now, in the current late modernity stage, there is no longer unification by religion nor strictly regulation by sovereign states (which strictly implies to be subject to land and tradition) but a large-scale pattern formation of *model behaviors* for predictive analysis. This is directed by the political and economical orchestration behind some of the uses or misuses of artificial intelligence. And it also has already a name: *behavioral big*

[37] See later the discussion on *values* related to Simondon's considerations.

[38] In his analysis of the prevailing conditions of cultural pluralism and the absence of values, Bauman shared an important warning:

> The real dilemma is one not of living with values, versus living without, but of readiness to recognize validity, the «good reasons» of many values and the temptation to denigrate and condemn the values other than the ones currently chosen (2000, p. li).

[39] Sacred belief systems as a unifying element of pre-modern civilizations has been extensively analyzed by Giambattista Vico in his work *New Science* (1744).

data (BBD)[40] [41] which includes online behavioral advertising, behavioral targeting, neuromarketing, profiling, algorithmic behaviour modification, and others (Beales, 2010; Stachl, et. al., 2020; Greene, Martens & Shmueli, 2022; Woods, et. al., 2022; Briesemeister & Selmer, 2022).

What does it imply that behavior operates according to patterns? It means, for the disappointment of many, that individuals hardly ever behave randomly. One of the most-well known machine learning experts (already introduced in the last section), Ethem Alpaydin, explains: "[...] there are hidden factors that explain customer behavior. It is this inference of a hidden model- namely, the underlying factors and their interaction- from the observed data that is at the core of machine learning" (2021, p. xiv). The patterns governing behavior come exactly from sensory-rich devices, such as smartphones, measuring, detecting, tracing and recording every digital footprint (along the axis of time and average use) from screen and phone activity (communication and social behavior, apps usages, information from other devices connected to the smartphone), location, consumption behavior, physical activity, and more:

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[40] In April 2022, the prestigious journal *Nature* exposed the difficulty for academics to access documents or information regarding human behavioral data and the algorithmic techniques used for their manipulation. Cf., Greene, et. al. (2022). Their definition of BBD is the following:

> BBD refers to the very large and rich multidimensional datasets on human and social behaviours, actions and interactions generated by our daily interactions with the internet and social media platforms, mobile apps, internet-of-things (IoT) gadgets and more. Companies, governments and data science researchers acquire and analyse BBD to improve products and services, assess public policy, extract knowledge, make scientific discoveries and develop and evaluate data science methodologies [...]
> To conduct meaningful and generalizable research, academics need not only access to human and machine behaviour data, but also access to (or relevant information on) the algorithmic mechanisms causally influencing human behaviour. Yet such access remains elusive for most academics. (Greene, et.al., 2022, p. 323).

[41] It shall not be confused with "online behavioral advertising" (OBA) or "targeted advertising"; these, in a more restricted sense, focus on advertising as a mode of influencing and modifying behaviors from the user's collected information. BBD also implies the evaluation of data with these aims but can also, in a broader sense, be understood as any methodology behind user's data (e.g., algorithm's selection of incoming content on the newsfeed) and not only individual targeting for advertising. Cf.: Boerman, S. C., et. al., (2017).

> Such data are derived only from what is actually observed when using an application or device and are a small subset of our possibly observed behaviors. Further, this narrow subset of recorded behaviors must be converted into a digital (database) representation supporting ML algorithms. Information is lost during the transformation of unstructured data (text, pictures, images, videos) into structured data which can be represented in matrix form. Lastly, the database representation is projected into feature space (Greene & Shmueli, 2019, p. 2).

That projection in feature *space* is where we already occupied and extended most of the Second Part of this work (Sect., Chapter V). Following the explanation of the mentioned authors, from the *computationally observed* online behavior, each "person/ individual" becomes a "feature" that is represented by a matrix of numbers within a coordinate axis (Kelleher et al., 2015, Greene et. al., 2019). From this feature vector a certain outcome is predicted. Each number represents not only a feature but a "cultural feature". A data-driven approach in culture, what we call by the very title *automated patterns of culture*, implies the automation of any of its cultural features:

> [...] by simply using the items that an individual has liked on [a social media platform], data-driven models can accurately predict that person's sexual orientation, political and religious views, intelligence and personality traits, and use of addictive substances such as alcohol, drugs, and cigarettes; they can even determine whether that person's parents stayed together until he or she was 21 years old (Kosinski, Stillwell, and Graepel, 2013 in Kelleher and Tierney, 2018, p. 200).

Cultural features, simply described, are vector functions representing *values* coming from classifications of, essentially, the non-calculable dimensions of culture: beliefs, opinions, desires, emotions, or as Han describes them: "the deeper layers of the soul - with its hidden wishes, needs and desires" (2017, p. 20). This resembles what Stiegler considered as stocks of "cultural data" (2011). What is calculated is the non-existent, it is a calculation, manufacturing, and projection of mathematics in the void of culture. To quote Stiegler:

> Objects of belief are not existent, and this is why they are not calculable. [...] Objects of belief are objects of desire [...] belief is the social and transindividuated translation of desire [...] what is sometimes called, in a vague and ambiguous way, «values». (2013, p. 67).

In consideration of our analysis, when a cultural feature is spatialized (a data point in coordinate axis), it becomes immobilized, it becomes part of the criteria of a pattern. The relations between the most diverse possible cultural features (properties belonging to a data point) are the ones that give a simplified pattern (which is narrow and often biased) of the user-item matrix. The spatialization of the features (vector space) is the birth of a limit and the acceptance of many exclusions. But does this imply *reducing* cultural features to mathematical objects? No. The freedom of mathematical relations and objects rather belongs to the deep dynamic that adjusts or approximates (partially) to the actual cultural reality, indirectly affecting and modifying it at the same time, it does not necessarily reduce it. No data scientist nor skilled engineer would claim to know exactly the pattern of their customer's behavior, but only a *useful* approximation derived from their past behavior (collected data).

The collected data can be reused for the most diverse purposes, among them, to infer the behavior of some user by means of the data of other users with similar features and vice versa: "In other words, personalization can still occur when the personalized scores are based on the behavior of others sharing the same social identity as the focal user" (Greene & Shmueli, 2019, p. 3). This runs the risk of creating what many authors call: *homophily*, namely, limiting and reinforcing similar traits such as those found in social networks (Bakshy, Messing, and Adamic, 2015) also similar to what Stiegler referred by the name "artificial crowds" or "social mimetism and herdish behavior" engendered by the psychotechnologies themselves (Stiegler, 2006, 2009, 2010 [c. 2008]) and where the *I* and the *we* synchronize to the point of annihilating their differences (2009, p. 41). This returns to the idea of being mostly ideologically exposed to those who hold similar views while creating "echo chambers" which are continually reinforced by algorithms feeded by the user's behavior. This gives place to "filter bubbles":

> Status homophily includes the major sociodemocraphic dimensions that stratify society - ascribed characteristics like race, ethnicity, sex, or age, and acquired characteristics like religion, education, occupation, or behavior patterns. Value homophily includes the wide variety of internal states presumed to shape our

> orientation toward future behavior (McPherson, Smith-Lovin, and Cook, 2001, p. 419).

In other words, “homophily is the mechanism by which individuals «stick» together [...] is a «pervasive fact» that governs the structure of networks” (Chun, 2019, pp. 76, 79). How do we measure similarity? in the input representation, namely, in the attributes chosen for the model (Sect., Part II for a technical description). As we already know, this notion of grouping by similarity can not exactly match the diverse cultural attributes of users. There are three key arguments for this claim: first, the data on which the model will be fitted come from a specific contextual input data (linguistic, national, and others), second, the values of the selected attributes are dynamically subjected to change, and third, the data is produced or obtained within the narrow context of application while limited by the trade, governmental and data protection law relationships. Nonetheless, even taking into account customs and values differences, such algorithmic practice on cultural features is becoming widespread. Why? Because as it has been proved to a large extent, “users do not randomly explore different topics, but instead tend to view multiple accounts offering similar content” Greene & Shmueli, 2019, p. 4). Despite the culturally based differences (language, values, socio-economic context, and others), there are still regularities in the observed patterns of human behavior. While most believe that generalization is unfeasible in cultural studies, machine learning is increasingly testing the limits of this claim. All machine learning is about moving from particular cases to general models. It is the new emerging force of producing, modifying, or preserving patterns of culture. In a more technical sense, these authors explain:

> A 10-dimensional feature vector of a person, for instance, represents a person as an array of 10 numbers, derived from measurements of their observed behavior, and replaces the «person» with a single point in 10-dimensional feature space. Once converted to a point in feature space, the «similarity» of this person to others can be computed by measuring the distance between this point and others in the feature space. Points closer to each other are deemed more similar. Depending on one’s modeling and predictive goals, this can indeed be a useful approach. But like any good metaphor, the feature vector approach emphasizes certain similarities at the expense of certain dissimilarities. When we represent a person as a feature vector, we tend to forget the long abstraction process that preceded it (Greene & Shmueli, 2019, p. 2).

Behind this, we have no complete access to the understanding at all of the underlying (algorithmic) narrowed-down mechanisms for modifying and regulating behaviors. This is how the automated patterns of culture are rapidly turn into *dark patterns*[42] where any soul-destroying factors can be combined. Rather than collecting data, automated technology may collects souls (i.e., Plato's *psuchē* generally understood as mind).

Throughout his works, Simondon relied on Plato's theory of the symbol understood as pairs of complementary realities. Complementary reality implies symbols that have been split off from an integrated and unified reality or totality, symbols are "half of an original whole" (CI, 326, own translation). This is followed in a few lines. We have to channel another argument to keep track of the previous problem, those of the dark patterns. What do *values* precisely mean?. The answer becomes evident in Simondon's definition of value as a symbol of integration of complementary realities. In the *Note* entitled "Values and the Search for Objectivity" which in the initial edition opened with the question: "What can be understood by value?", he wrote:

> Value represents the symbol of the most perfect integration possible, i.e. the unlimited complementarity between the individual being and other individual beings. Value supposes that there is a way to make all realities complementary, and the simplest way is obviously to suppose that everything that exists is integrated into a universal will; a divine finality (CN, 403).

If, following Simondon, *value* is a symbol of the most perfect integration of complementarities in society, we can critically raise the question of; what values lie behind putting (opaque) algorithms (black boxes) at the service of behavioral models? The answer may surprisingly be: carrot and stick. Contemporary culture, hyperculture, can not be described by

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[42] Dark patterns in this sense do not refer to the original definition but to the underlying mechanisms for behavior modification. The concept of "dark patterns" was initially conceived in 2010 by Harry Brignull in order to evidence improper strategies in the user's online interface in order to obtain their data. The improper strategies mostly lead the user to take measures or actions that in the first instance were not the ones desired by the user. These strategies range from: forcing the user to subscribe to a newsletter or seeing advertising in exchange for access to the website, accepting undesired emails, hiding the unsubscribe option, improperly displaying "accept all" cookies, tracking instructions in-app browsers, buying or signing up tactics, and many others. Dark patterns are misleading designs to increase the company's revenues.

common values to be integrally shared within the community, there are no shared codes in pursuit of a common goal (*τέλος*) but the endless algorithmic *rewards and loss* driven by attention economy: "We are now in the habit of perceiving reality in terms of attraction and surprise" (Han, 2022, p. ix). What does this resemble? a cause-effect black box operating system. This is what Jaron Lanier already warns in one of his latest works, *Dawn of the New Everything* (2018)*,* when he recognizes the potentiality of new technologies as potential Skinner boxes[43]:

> The postwar war period was haunted by the fear of mind control. Psychologists like Ivan Pavlov[44], John B. Watson, and B. F. Skinner had shown that the application of controlled feedback could be used to modify behavior.
> The Skinner box was the archetype. [...]
> Wiener extrapolated that computers might become powerful enough to run fancier Skinner boxes, more effective, harder to detect, and infinitely creepier [...]
> In the original experiments, a live scientist was at the controls, but these days, it's an algorithm (Lanier, 2018, pp. 58, 60, 61).

Retaking Lanier's observation, as Wiener indicated, cybernetics is the art (*tékhnē*), it is the technique of navigation for piloting or governing a ship. The ship is the computer. But

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[43] The Skinner box based on the «law of the effect» consisted of a stimulus mechanism to condition the behavior (initially practiced with animals) which has been carried out in a controlled environment. Such psychological experiments have also been associated with a child's learning process. Reinforcement learning implies the reward (positive stimuli) or discourages (negative) during the children's learning process and, by doing so, conditioning its behavior. Nonetheless, Marvin Minsky, for example, did not concede that such practices proceeds in the same way for humans:

> However, while this may apply to some animals, this idea of «learning by positive reinforcement» does not account for so much of how people learn because, frequently, failures help more than success do, when we try to acquire deeper ideas (Minsky, 2006, pp. 37-38).

[44] Le Terrier and Simondon of 1957 in "Modern Psychology" introduce Pavlov and his proposal of the "conditioned reflex" as an emblematic contribution of the experimental method in psychology (1957, p. 1668, 1669). The method of the conditioned reflex results, from their physiological interpretation, in relation to the configuration of relations between stimuli or inhibitions and the temporal nerves in the brain.

which part of the computer? The one that performs feedback mechanisms (communication and control) in the context of data provided by humans in-context. A ship, a computer or a Skinner box responds to the very milieu where to regulate behaviors. Under the computational sophistication of today's machine learning techniques, how is the ship piloted?: by finding, regulating, and creating patterns of behavior at all costs. In a general sense, algorithms (which also imply a domain expert of humans defining their data and parameters) govern the ship, they mediate (even without noticing) through the psyche[45] between the *configurational-patterns* and the world.

While Simondon emphasized ignorance and, therefore, alienation from the knowledge of the general functioning of the machines that mediate our lives (Sect., Part II, Chapter V, §2. 2.2), today we can speak of a deeper phase of alienation that derives from a dis-attention or unaware attitude towards the use of technology. Black boxes technologies can be greatly thought of as "technologies of the unconscious". Down the line of these arguments, the current techno-cultural conditions lack the *reform of culture* as Simondon sought to elaborate which is: human *awareness*/ *noetic possibility*[46] of technology and its subsequent *integration* into Culture[47].

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[45] According to the psychological analysis of Acerra, et. al. (1999), regarding facial recognition in an infant, Minsky points out that the child, long before forming an "internal model" that serves as a reference of his value system (which he calls *Imprimers,* that is to say, the model that the child follows for most of his learning process), must first be able to distinguish them. In order to distinguish facial features from *imprimers* (i.e., generally, its parents), the infant does not recognize each particular feature of the eyes, mouth, nose, but general patterns: "infants may react less to the features of the face, and more to its larger-scale, overall shape" (2006, p. 57). Hence, as Francesca Acerra points out, the infant "look longer at their mother's face than at a stranger's face- but not when the mother wears a scarf that hides the hair contour and the outer contour of the head" (Acerra, 1999, in Minsky, 2006, p. 57).

[46] "Noetic possibility" is a concept elaborated in Stiegler's work: *States of shock* (2015, p. 16). So much Plato as Aristotle elaborated on the concept of *noēsis*,. The former, platonic roots, implies the principle of intuitive thinking coming from the ideas on the epistemic level of knowledge while, for the latter, aristotelian view, although the noēsis also implies intuitive thinking it does so from immediate and effective reality. For Stiegler the concept constitutes the very condition of *la Raison* (*Aufklärung*) but it demands for constant actualization in order to fight against the threatening unreason of stupidity (*bêtise*).

[47] For this, Simondon indicated that it is necessary to find crystallized in the structures and functions of the machine the human reality itself. Now, in order to know the functioning scheme of the machine, Simondon rejected the diversification of knowledge through the specialization of each type of machine as well as its taxonomy according to its various uses and proposes, instead, to think of them in a universal way: "Moreover, these fundamental

The digital technological development has not provided culture with common codes and values[48] but has functioned as a producer and reproducer of behavioral patterns and therefore, models that accelerate the process of *des-individuation*. Des-individuation leads to the unity of form (uni-form) to the copying of patterns that have been algorithmically detected and directed to the group in question. Identifying patterns (with automated algorithms) to modify values (shared or not) in culture is one of the most important psycho-political and psycho-technological enterprises of this century, we refer to this in terms of *psycho-politics*, a concept initially coined by Han (2017).

We referred at the very beginning of this chapter to the loss of the *kosmos*. None transcendental death is ever in vain. This century is heading the great consequences of *systemic destruction* promoted by: the ideas of simulations (imitations) of reality (hyperrealism), instantaneous and constant interconnection (hyper network connection), strong consumerism (de-spiritualization), ontological nihilism (de-motivation), individual paranoid-anxiety (panic behavior[49]), hyperproductive self-management (self-care oriented), weak and multiple identity (identity politics), and "narcissistic psychocentrism"[50] (mass media industry). With all these self-inflicted elements *virally* well-distributed in culture, the giant factory of *stupidity (bêtise)* (Deleuze (1968), Derrida (2001-2002), Ronell (2002), Stiegler (2015, 2016)) became enthroned. Namely, this century has begun to face the cultural and political consequences of

schemas of causality and regulation that constitute an axiomatic of technology, must be taught in a universal fashion, in the same way the foundations of literary culture are taught" (MEOT, 19).

[48] Contrary to the contemporary scenario, the mythical-religious character of pre-modernity provided a grade of general stability to all previous civilizations through common codes and values shared within the community. This might also clarify why *individuation* had played a fundamental role in the late scholastic medieval thought. Particularly in: Thomas Aquinas, Duns Scotus and William of Ockham but also much earlier in Boethius,. Cf., Gracia, J. J. E. (1988, p. 11). In his extended analysis, Giambattista Vico (1688-1744) has been the very thinker who understood that the elements of religion were the vital and unifying key of previous civilizations and that the decline of nations does not only occur according to stable laws but coincides with the loss of a sense of transcendence and sacredness (*sacro*) in culture.

[49] This is noted by Steigler in his work *Uncontrollable societies of disaffected individuals* (2013, p. 4).

[50] This concept has been recovered from Stiegler in his work *States of shock* (2015, p. 36).

systemic destruction[51] [52] at its greatest peak or as Stiegler has once written "the liquidation of systems of (cultural) care" (2010, p. 152).

Once the mind ceases to be indecipherable and becomes the consequence of probabilistic and statistical structures at play, it no longer bears *rationis potentia* (the potentiality or power of reason), but becomes a *model or pattern potentia* (a little more or a little less: *predictable*). This has severe repercussions at the very heart of culture. The *rationis potentia* loses strength in the face of the *pattern potentia*. How? By, as we underlined before, introducing "cultural viruses"[53] in all possible media (predominantly digital media) while attracting and influencing public attention and opinion towards "fixed models" or "labels" fueled by the so-called "cultural agenda". When penetrating a system of (already weakened) values these viruses multiply rapidly while destroying every entity belonging to, for example,

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[51] Although Ruth Benedict remained critical to the "uniformity of custom" of the white civilization, she greatly recognized how other cultures have experienced the decline of their institutions: "They have seen their religion, their economic system, their marriage prohibitions, go down before the white man's. They have laid down the one and accepted the other" (1959, p. 20). Already at the beginning of the 20th century, she was in favor of defending the institutions of Western civilization, and emphasized that they "must be protected at all costs" (p. 20).

[52] According to Baudrillard, *destruction* is that which is located at the opposite side of production, and consumption is that which is positioned in between. Interestingly, consumption contains an unlimited dynamic that tends, according to him, to destruction and it is there where it fully acquires all its meaning (1998, p. 47).

[53] To recall a very well-known example: social media (no need to name examples) is a mechanism for the transmission and reproduction of "cultural viruses" (e.g., memes, targeted advertising, automated feed ranking system, prevailing filters, and others) which generate transformations in psycho-collective behavior. One of the first to recognize that cultural information has become viral is the already mentioned US philosopher, Daniel Dennett. He underlined that the "transmitted cultural information" that is copied, replicated and propagated has several profound implications in our model(s) of the world. In Dennett's analysis (2017) he makes an analogy between the genetic code (DNA) and the digital culture code (HTML), pointing out that while in the former the information that is transmitted can give rise to errors (which may or may not lead to the improvement of the species), the latter, transmits information in a way that begins to wipe out the language, traditions and practices of a particular culture. With this, he tries to warn that not everyone is (psychic) immune to the cultural garbage that circulates in the networks, and that this has already become a serious problem for culture in a general sense.

a system of traditional values[54] [55]: sovereignty, religion, family, identity-retaining system[56], and others. This is not a new critique. Bernard Stiegler already identified these contemporary problems more than ten years ago: "And the aim is to impose behavioral models that are the exact opposite of everything that would constitute education, whether that is familial, religious or national" (Stiegler, 2015 [c. 2012], p. 24). This idea was embryonic already in all volumes of *Mécréance et Discrédit* when referring to the "destruction of many other systems, such as the family, the state, the biosphere, and so on, and especially the psychic system itself [...], inevitably leading to a process of generalized disindividuation" (2014, pp. 32-33) and can even be traced to his work *Taking care of youth and the generations* (2010 [c. 2008]) where the administration (ἐπιμέλεια) upon attention leads to the destruction of attention itself:

> This destruction of attention is disindividuation, and this in turn is precisely a deformation: a destruction of the formation of the individual that education has constructed. The work of forming attention undertaken by the family, the school, the totality of teaching and cultural institutions, and all the apparatuses of "spiritual value" [...] in the effort to produce a consumer stripped of the ability to be autonomous either morally or cognitively - to have conscience as free will (Stiegler, 2010, p. 184).

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[54] For Stiegler, *value* has a double dimension: on the one hand, its collective, psycho-social aspect, which requires processes of sublimation before authority (the super-ego) for its internal coherence, and on the other hand, as an individuation of singularities: "Value has worth only to the extent that it is inscribed in the circuit of individuations and transindividuations, and these can only indicate singularities" (2013, p. 80).

[55] As early as the dawn of modernity, Georg Simmel significantly saw the decline of Western culture. In his work, *The Conflict in Modern Culture,* Simmel wrote:

> The basic impulse behind contemporary culture is a negative one, and this is why, unlike men in all these earlier epochs, we have been for some time now living without any shared ideal, even perhaps without any ideals at all (Simmel in Bauman, 2000, p. xix).

[56] An identity-retention system can be understood in the following sense: "In the past, differences of birth, blood and religion were not exchanged: they were not differences of fashion, but essential distinctions. They were not «consumed». Current differences (of clothing, ideology, and even sex) are exchanged within a vast consortium of consumption" (Baudrillard, 1998, p. 93).

This *de-constructed* consumer is more easily managed, controlled, and predicted than a *constructed* individual who's cultural features are value-based by customs and traditions. We are embedded into anti-systemics, destructives, and deeply unconscious cultural practices. How might we *breathe-in* after this? The great step might be to create what Simondon considered as "technical awareness", which now shall imply the *pattern awareness*: to be aware and well-educated, or in terms of Ruth Benedict, to be "culture-conscious" of the fact that there are models of behavior ready to alter our psychosocial behavioral patterns[57]. "Such instruction would have to teach strategies for *paying attention to psychotechniques of attention formation*, paying attention to technological reflectivity" (Stiegler, 2010, p. 70). This implies not to ridiculously attempt to get rid of a culture based on automated patterns and models, but rather, to welcome it by grasping its patterns as an effective tool for cultural knowledge in order to reflect and analyze what are the models that govern and prevail in today's culture. This shall be able to create a responsible critical effort. However, in order to modify something it is necessary to have a system of shared-values so that understanding (*comprehendit*) can be aligned with the values of the culture and society as a whole. As Simondon wrote:

> The term culture includes a value judgment and to some extent refers to an axiological content. [..] It is always a technique: a technique of the constitution of collective or individual habits, of the learning of certain prohibitions and certain choices (*choix*) that define a psychosocial personality (CT, 315, 317, own translation).

If cultural and political life shall take anything into account in order to create a coherent exercise of its activities (praxis), it is to be clearly informed about the existing or potential models created through data. In the 21st century, making policy decisions without shared (common) values and without the good-quality of available data would reproduce and multiply the past and present state of problems. This calls to play for two highly interdependent stakes: the political program shall begin to be exercised, reconstructed, and *most of all* conceived by those who, *velis nolis*, study politics at the level of technology. That is to say, we shall let a true *τέχνη paid-agogy* or *tecno-paideia* to occur. For it is no longer possible to achieve a clear

57 It is also applicable to what Stegler did not see in the new technologies but in the American classification of pathologies and cognitive methods along with the standardization of chemical treatment, that is, the arrangement of "behavioral model that would be completely standardized [*normalisable*], that is, calculable" (Stiegler, 2013, p. 96).

decision making without technical and pattern awareness[58], and vice versa. What kind of policy decision-making can be of any good without the analysis and understanding of data at stake? This requires rethinking Simondon's project of ecumenical culture: to bring together (cultural-political) thought and technology, so that the former integrates the latter.

§ 2. *Dés-individualisation,* dis-individuation, and des-individuation

We had already lost the *kosmos* over centuries ago, now we are losing reason (*Aufklärung*) too. In his work *States of shock* (2015 [c. 2012]) Bernard Stiegler exposed how we are witnessing the loss of the mastery of reason (rational knowledge, maturity[59]) against unreason (stupidity, madness) while attention is being absorbed and capitalized by the market of behavioral models. In view of his analysis, the main philosophical-political thesis in this work reintroduced Naomi Klein's analysis in her work, *The Shock Doctrine: The Rise of Disaster Capitalism* (2007) in order to disclose that the shock therapies (technological shocks) of the capitalist market lead not only to the regression of individuation (of thought itself) towards systemic stupidity and collective trauma, but also to the destruction of educational programs of the mind's training (*paideia*) at all levels. The "light" of the indefinite progress has begun to blind so critically that Stiegler, recovering the *Dialectic of Enlightenment* (1944) from Adorno and Horkheimer, recognized the present event as the crisis of the regression (*Rückschritt*) to unreason. In this psycho-collective trauma where civilization and reason destroys themselves the processes of *dis-individuation* take place.

In the absence of a critical and rational sense, in the face of the obsolescence of *Aufklärung*, namely, against the myth of indefinite progress Stiegler discovered: the de-formation of knowledge, the liquidation of sovereign politics, the crisis of education, the globalization of ways of life, the dis-identification with the local cultures, the symbolic and spiritual poverty, the apathy or nullification of hopes and goals in life, the destruction of

[58] A program and reform of such a magnitude requires intellectual efforts that still are not formally established on the agenda of today's discourse and perhaps had only started after the spread by the media (2022-2023) given the implications of the ChatGPT-3.

[59] Stiegler took up the Kantian meaning of these terms, which he made clear: "sovereignty founded on *Mündigkeit*, maturity or majority understood as the exit from Unmündigkeit, immaturity or minority" (2015, p. 2).

processes of psychic and collective individuation in the face of post-industrial[60] or hyper-industrial[61] *adaptive* societies[62]. All leads a way down to the production of patterns of behavior fueled by psychotechnologies.

When the reign of stupidity and de-spiritualization grows, that is, "the triumph of nihilism" (Stiegler, 2013, p. 41), *no assistance* of the dynamics, hybridizations, non-anthropocentric view, and de-substantialization of the human is required (as posthumanism generally attempts to assert). Rather, what becomes a greater urgency is the opposite, the pharmacological effect, the *object of a care* coming from more austere, cautious, and conservative analysis. Stiegler, inadvertently, comes to occupy that very place: "for the first time in the history of humanity and of its inhumanity, stupidity rules *as such,* totally and shamelessly" (Stiegler, 2014, p. 33). It is now time to answer the question: how does our concept of des-individuation differ from Stiegler's conceptual proposal of *dis*-individuation, particularly *psychic disindividuation*, and to what extent are both related to Simondon's? We reserve the original French expression (*désindividualisation*) for Simondon, the English translation (*disindividuation*) for Stiegler, and we introduce our political-cultural concept (*des-individuation*) as the major analytical tool in this section.

2.1. ***Dés-individualisation* in Simondon**

There is already a first trace of ontological-political articulation through the concept of *désindividualisation* (*disindividuation* in the English translation) brought by Simondon in his main thesis *Individuation…* from 1958. Although he employed the concept only once without

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[60] As Gere (2008) points out, the concept, post-industrial, has already been employed in the 50s (Bell, Dahrendorf, Machlup, McLuhan, Ellul, and others) but it mainly gained notoriety through the American sociologist Daniel Bell in his book on *The Coming of the Post-Industrial Society* (1973).

[61] In hyperindustrial societies, according to Stiegler, there is a final integration of the tools for producing goods, the service-based techniques, the diffusion of symbols together with the world of culture and spirit all operating together in a vast techno-industrial system. Cf., 2009, p. 55

[62] Hyperindustrial societies do not progress nor are they controlled, they are adaptive societies, they adapt to consumption techniques. This is how Stiegler formulated it: "Techniques of adoption, such as marketing, can develop only because of the generally hidden and forgotten fact that society is already a process of adoption" (2009, p. 44). Following his advice, literature on the process of adoption, can be found in: Ernest Renan, Paul Valéry, and André Leroi-Gourhan.

defining it clearly, he indicated that *désindividualisation* is structured and produced through emotions, and likewise, emotion is the ability to dis-individuate. Emotion is a regime of variation or continuous individuation driving and relating the psychic dimension towards the collective, towards the transindividual.

> Emotion is a discovery of the unity of the living being , just as perception is a discovery of the unity of the world; these are two psychical individuations that extend the individuation of the living being, competing it, perpetuating it (ILFI, 289).

The seminal germ of emotion is *attention*: "attention formation is also what Gilbert Simondon calls the «transindividual»" (Stiegler, 2010, p. 17). Therefore, for Simondon, to dis-individuate constitutes the access into a much expansive form of individuation. He defined it in the following terms: "emotion, the capacity of the individuated being to provisionally *disindividuate* in order to participate in a broader individuation" (ILFI, 180, own italics).

The affective-emotivity order[63] drives the foundation of psychic-collective individuation. Although related, Simondon differentiated emotion from affection as follows: "emotion is integrative and richer than affection; [...] emotion is the organization of affections" (ILFI, 289, 290). According to Bathélémy: "[t]he term «disindividuation» refers to a very particular phenomenon that can generate emotion in the bio-psychic living, and that makes possible in its turn, as long as this phenomenon is temporary, the passage to the psycho-social – or the transindividual" (2012, p. 214).

[63] Cf., Celis Bueno, C., & Schettini, C. (2022) for a contemporary exploration of the affective-emotivity order.

Following Simondon's analysis, emotion[64] is what allows diverse subjects to access the collective, to amplify their different metastabilities into a *common signifier*[65]. Simondon called this event "group of interiority" or "interiority groups" (ILFI, 328). Political life or social order is an example of a group of interiority: either ruled by natural right force (driven by law of force or heroic law) or by the use of reason (driven by civil law)[66] both can be understood from an initial triggering emotion, which afterwards, is able to assemble individuals into an "interiority group", that is, under common assumptions[67]. From a political-philosophical perspective emotions reveal themselves not precisely as a substance but as a potentiality and moral quality concretized in political obedience[68].

The potentiality of emotion redefines the collective and transductive processes to a great extent. Emotion is not a product that has begun to be exploited in our days for economic and

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[64] The importance of emotions in the very foundation of the cultural processes has its effects on the political culture as a whole. As Cassirer noted in one of his posthumous works, *The Myth of the State* (1946), the role of the emotions is already at the very origins of the mythical-religious political thought. At the time, we can find figures like Hesiod and Homer, what Aristotle called *philómythos* (lover of myth) who unveiled the world's views by constructing and spreading their myths. Against this, was the early attempts at rationalization, first by Xenophanes and then by Plato, who tried to halt the proliferation of myths elaborated by the poets of mythology (Bos, 1983, p.2). Still, the category of myth is both necessary and relevant in pre-modern culture to such an extent that Plato himself was responsible for elaborating his own myths. This poetic foundation of the myth is what later political romanticism will attempt, to some degree, to rehabilitate as clearly expressed in figures like Novalis or Schlegel who made the last attempts at the mythopoiesis (*μυθοποίησις*) in history. By contrast, the rationalization of the world, whose best expression is found in the enlightenment, is an attempt to lay aside any formation of emotions in pursuit of calculating reason.

[65] The singularity or germ of openness is transductive when it operates in conditions of metastability triggering a collective individuation. Sect., Part I, Chapter III.

[66] This differentiation belongs to the analysis of Giambattista Vico (1999 [c. 1744]).

[67] Georg Lukács, in his work, *The Destruction of Reason* (*Die Zerstörung der Vernunft*), argues that German philosophy surrendered to irrational romanticism, abandoning enlightened rationality, which led to the disastrous political processes of the mid-20th century, based on the phenomena of vertical power structures. An analysis concerning the emotional and irrational factor that cause enormous biases in the field of modern political thought, has been analyzed by Cassirer in *The Myth of the State* where he recognized the emergence of irrationality embodied in the myth or primitive human stupidity from which the myth (*Urdummheit*) is born as one of the most dangerous factors of modern thought.

[68] This is based on affective-emotive postulates such as: fear of death (law of force), admiration of honor in armed combat (heroic law), likewise, political obedience exposes its emotional attributes not because of fear or honor but because of emotions of respect and "love of humanity or morality" as Bergson analyzed. Cf. Bergson (1977, [c. 1935]).

political purposes, it has become the very means of production. Although emotions have always articulated the "groups of interiority" in one way or another: "[e]motions have become a means of production only in our times" (Han, 2017, p. 45). Emotion is a true unit of symbolic production. In virtue of this idea, Stiegler reminds us: "Now, desire is, firstly, engendered by way of the symbolic. And symbolic production is today, for the great majority of the populations of the industrial democracies, the work of the culture industries" (2011, p. 24). And what produces the symbolic value? It produces a large number of behavioral patterns, behaviors not based on rational deliberation but on the passive rewarding system (carrot and stick) together with permanent innovation. The commodification of emotion in the culture industry, i.e. the technological mediation of emotions and attention, unearths the foundations of behavioral patterns: "the culture industries have become organs capable of creating identification processes via behavioral models, behavioral models which are themselves incessantly renewed according to the demands of innovation" (Stiegler, 2011, p. 10). Behavior only gains access to cultural analysis on the basis of its symbolic meaning: "culture can only be effective if it possesses from the start this capacity of acting on symbols and not on brute realities" (CN, 404) wrote Simondon.

Simondon's study of emotions and its transindividual state (the collective) came from his analysis of individual behavior in the context of the social groups. He recognized a crucial feature in the political-philosophical readings of four different sources: the first one, Bergson, from whom he recovered the notion of "closed" and "open" society[69], the second one, of Kurt Lewin from whom he worked on the notion of "in-group" and "out-group", the third one, of the cultural anthropology of his colleague Mikel Dufrenne who also analyzed the personalities and cultural aspect behind "reciprocal causality", and the last one, of Abram Kardiner who studied the passage from individual-group-society to nature-personality-culture (Heredia, 2017, p. 383).

Now it is clearly discernible that if individuation responds to progressive, differentiating and inter-individual tendencies, *désindividualisation* would tend antagonistically to the regressive, homogenizing and collective tendencies. These are processes that coexist simultaneously in tension. The first is a *ἀποφάσκω* process, in which, while individuating, it denies some characteristics of the general, the second is a *καταφατικός* process, which identifies itself with the attributes of the collective and the general. For Simondon this is in no way seen as a negative trait, but on the contrary, the *désindividualisation* is the complementarity that

[69] Also see, footnote 61 in Part I, where the open/close machine concepts are described.

coexists in enriching tension with individuation. When does *désindividualisation* occur? in the passage from the psychic individual to the psycho-social collective. In a precise political reading of Simondon's "psychic domain" Muriel Combes in the section called "Affectivity and Emotivity: More-Than-lndividual Life" diagnoses the following:

> To put it more precisely, affectivity, the relational layer constituting the center of individuality, arises in us as a liaison between the relation of the individual to itself and its relation to the world. [...]
> [T]he subject can truly resolve the tension characterizing it only within the collective; the subject is a being tensed toward the collective, and its reality is that of a «transitory way» (2013, pp. 31, 32)

This means that the psychic or affective life of the individual undergoes processes of vital individuation towards psychosocial individuation not closed on itself but open to different relations. To better grasp this *désindividualisation,* we can classify the subject's emotions at least on three major types: in relation to itself, in relation to the external world, and finally, in a transindividual relation which converges the first two types.

i) In the former case, if the subject (being) is immersed only in itself, in its individuality, and thereby, refuses external mediation, *anxiety* is produced, i.e., the "being's departure" (ILFI, 285):

> Anxiety is therefore this very particular emotion that calls for the realization – which is, however, most likely impossible – of the I without the We. This means that the passage from vital individuation to psycho-social or «transindividual» individuation via the psychic «transitory path» will have to be provoked by an emotion that is not anxiety. Unlike the latter, the emotion that opens on to the transindividual provokes a «*disindividuation*» [...] that is merely provisional and that enables the subject to take hold of itself through the collective (Barthélémy, 2012, p. 206, own italics).

ii) In relation to the external world, the tension of the pre-individual charge with respect to the collective[70] brings to light the affective problematic: "the collective is necessary for emotion to be actualized" (ILFI, 286). Is emotion the reference of the collective? No. Emotion is a *necessary condition* for the collective. Without emotion, the collective can not take place at all. Emotion comes from *émouvoir*, it is a continuous movement, it is born in the pre-individual and always *moves towards* while being captured through the collective. And here is where Simondon's concept-tool greatly pays off: *emotion places the behavioral structure of the psycho-social. That is a great reason why*, at the heights of algorithmic sophistication, *behavior can be studied in social engineering labs by means of "attention" as a commodity*.

Models of behavior can be studied from attention leaked in the digital platforms because attention belongs to an emotional-affective attribute and the emotional dimension is what precisely governs the psycho-social at its core. Attention is a feature of affectivity within the broader structure of emotion.

iii) And finally, the transindividual relation[71]. Transduction (the superior or broader phase of individuation) represents the informational phenomenon par excellence (Sect., Part I, Chapter III, §2.). Information (neither internal nor external) is propagated and transferred progressively in a milieu by modifying its previous local states. The triggering of this *hierarchically, logically, and ontologically* superior individuation (ILFI, 111) allows the emotions to outbreak not in an organized manner but by abrupt/quantum leaps which, since it is affective-emotional, it also admits logical contradiction[72].

[70] While we use here the concept "collective" in a broad sense, Simondon traces in *Individuation* and in *Note complémentaire* the difference, as Bardin indicates, between (biological) community and (ethical) society. Cf., Bardin (2015), pp. 51-66.

[71] Through the method of transduction, which is analogy (not similarity), Simondon puts in relation the psychosocial aspect of a society with that of a machine:

> The veritable limits of the *concept* of television are thus psychosocial; they are defined by the *closure* of a cycle of *recurrent causalities* that create a type of psycho-social interior milieu endowed with homeostasis due to a certain internal regulation by the assimilation and disassimilation of technologies [...] bound together by a mechanism of self-defense comparable to that of various closed societies (ILFI, 119- 120).

[72] "Logical contradiction is accepted here, for this thought is guided by affective and emotive themes" (ILFI, 120).

> The individual is not just the individual, for it is also the *being's reserve*, which is not yet polarized but which is available and lies in wait. The transindividual is with the individual, but it is not the individuated individual. It is with the individual according to a more primordial relation than belonging, inherence, or the relation of exteriority; this is why it is a possible contact beyond the limits of the individual (ILFI, 340-341).

> Neither an enclosed interior nor a pure exteriority without consistency, psyche is constituted at the intersection of a double polarity, between the relation to the world and others and the relation to self [...]. The reality of psyche is transductive, that of a relation connecting two liaisons. (Combes, 2013, p. 30).

Simply expressed, at the basis of emotions is the domain of the collective, that is, of the transindividual: "a mediation between perceptions and emotions is conditioned by the domain of the collective, i.e. the transindividual" (ILFI, 290-291). There is something, in the order of the *gregarious*, that functions as an amplifier of the relations of psychic reality and that resumes, extends, and brings into tension the unity of interior (psychical) (ILFI, 9) with the "reality existing outside the individual" (Combes, 2013, p. 29). Barthélémy noticed: "The psycho-social is of the transindividual: it is this reality that the individuated being transports with it, this charge of being for future individuations" (2012, p. 115). This is the highest phase of being as well as of information as a mode of transformation of existence itself.

Beyond the ontogenetic and epistemological complexity of the affective-emotive problematic in Simondon, which is not our main focus of analysis and would demand even greater detail, the collective, to borrow Spinozian[73] terms, increases both the power to act

[73] In Spinoza's *Ethics* (1677) *affectio* implies affection (power to act (*potentia agendi*) that can increase or decrease according to whether it is favored or harmed) and *affectus* (related to affections or feelings (love, hope, fear) and that do not represent anything objective from reality). The axiomatic link between "the social" or "the collective" and "the emotional" or "the affective order" is found, as Combes herself recognizes, in Spinoza:

> In Spinoza's view, consciousness, far from being a stable and autonomous entity capable of harboring free will, varies as a function of the globality of the «affective life» [...] between active and passive affects within the subject, as well as within passive affects, and between joyful passions (increasing our power) and mournful passions (diminishing it). Thus, what Simondon explains of the affective-emotive layer [...] is an understanding of the subject wherein relation to the outside is not something coming to an already constituted subject from without, but

(*potentia agendi*) and the power to exist (*vis existendi*). The transindividual, i.e., the set of relations (virtual and actual), which the individual is capable of bearing and producing, can always be enriched and multiplied.

To this point we have understood that *désindividualisation* in Simondon is associated with the affective-emotive problematic that serves, by means of transindividuation, as the basis for the processes of psycho-collective individuation. *Désindividualisation* was not initially designed as an explicit cultural-political concept but it can be easily read as one, just as Stiegler himself did.

2.2. *Dis*-individuation as psycho-technology

Stiegler took up Simondon's onto-methodological concept in a cultural and political sense: *dis-individuation* as a process of "psycho-power" as a mechanism of "psycho-technologies" or "neuro-power" with the regressive force of destroying all the individuation processes[74]. For Stiegler, dis-individuation leads to the loss of the feeling of existing[75] and even more, to systemic stupidity:

> [S]tupidity is «a properly transcendental question: how is stupidity (not error) possible?». This is the question of individuation and disindividuation. [...]
> The question of stupidity is the question of regression (of lowering, of baseness) in relation to this solemnity [*gravité*] with which thought progresses [...]
> Disindividuation is a deficient relation to potentiality, a failure of individuation, an inability to pass into action, that is, in the language of Simondon, an inability to individuate this potentiality as actuality (Stiegler, 2015, pp. 42, 47, 62).

Although we can notice clear conceptual distinctions on the definition between *désindividualisation* as employed by Simondon and *disindividuation* as employed by Stiegler,

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something without which the subject would not be able to be constituted. (Combes, 2013, pp. 30-31).

[74] And particularly, processes of individuation linked to thinking: "In order for a thought to exist, it requires not just a logical condition but also a relational postulate that allows for its genesis to be accomplished" (ILFI, 77).

[75] Cf., Stiegler (2011).

the latter has indeed taken up the purpose for which the concept was employed originally: the tendency to the collective, to the gregarious, to what Stiegler called "herd behavior" (2009) or "the herdish tendency" (2011), a tendency to con-form, to be uni-formed and, as a crucially important aspect, he turned *disindividuation* into its highest political expression: "a process of psychic and collective disindividuation that would be not only massive, but total" (Stiegler, 2015, p. 117). That is, individuation contains the transductive seed of a much greater political problem[76]. Yet, psychic individuation for Stiegler, as different from Simondon: "is immediately a collective individuation, as social energy" (2013, p. 22) so that Stiegler emphasizes much more than Simondon the collective condition of psycho-social affectivities. Psychic disindividuation, *en son fond*, is already collective disindividuation. This was not a casual choice, Stiegler knew, ahead of our time, that in the process of disindividuation, desire (understood as psychic energy and *intergenerational* production) is increasingly liquidated and that, therefore, psychic individuation can no longer concretize itself. Regarding the importance of value-transmission between *generations*, he wrote: "[W]hen controlled by the audiovisual cultural industries[77], psychopower destroys the transmission and education of philia, the intimate connection among generations" (Stiegler, 2010, p. 13). According to Stiegler, disindividuation not only leads to stupidity but to a *spiritual rigor mortis,* it leads fully into spiritual misery, dis-affection, de-motivation, de-reasoning.

The disindividuation of industrial democracies implies a decadence which is nothing but cultural decadence connected to political cynicism and social anxiety. But why is this necessarily decadent in the context of AI automated technology? One way of reading this

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[76] Every ontological tool suffers from a "dialectical tension". In other words, every ontological-methodological concept carries within itself its own antithesis. Thus, if we understand, as Badiou proposes, mathematics as ontology, exactly the same thing happens as what Stiegler suggested with respect to the concept of individuation, namely, it carries within itself its opposite:

> «There does not exist a set of all sets». This non-existence means that thought is not able to uphold the assumption by which a multiple, and hence an existent, might be the gathering together of all thinkable existents without at the same provoking its collapse (Badiou, 2006, p. 160).

[77] Under the name of "cultural industries", Stiegler gathered diverse technologies, all of them submitted to calculation: television, radio, "the Internet and the integrated system of telecommunications, informatics, and the audiovisual, the product of the convergence of electronic technologies" (2009, p. 48).

argument lies in the fact that the production of behavioral models or patterns configured through what we call "cultural features" or what Stiegler called "cultural data" are based on the commodity of attention (psychopower) and not on a system of values transmitted by the corpus of institutions and tradition. If individuation is a mode of existence, disindividuation is the denial of existence itself (Stiegler, 2011). The substratum of such a cultural and political problem is imminently ontological or, better said, ontogenetic. The problem of individuation has become the very cultural-political problem of our time:

> My hypothesis is that the motive of this misery is tied to the third strand of individuation (the individuation process of the technical system), and has not been the subject of either thought or critique - nor has it been the subject, therefore, of political action. [...] [T]he highly disturbing outcome of a massive process of disindividuation - that is, of the loss of both psychic and collective individuation (Stiegler, 2013, pp. 78, 79).

> The disindividuation process is what [...] I referred to as generalized proletarianization, and it is what leads to the loss of the feeling of existing. That is to say, to despair. This is the context in which spiritual misery is produced [...] in a hyper-vulnerable technological system. Such a situation is manifestly explosive (Stiegler, 2013, pp. 121).

> Disindividuation is a desubjectivation that affects social forms as much as the psychic subject, and as such it generates disbelief, miscreance, discredit, demotivation, and irrationality (Stiegler, 2014, p. 13).

Let it be clear that Stiegler first proclaimed the death of individuation in the first volume of *Mécréance et discrédit* to develop two years later, in its second volume, three different definitions[78] of the concept of disindividuation and deepened the psychological aspect in the third. Disindividuation becomes the new conceptual-analytical tool for the emerging century.

Stiegler bid farewell to Simondon's concept of individuation, perhaps already closing an entire generation of process metaphysics when he wrote: "there is no longer any belief in

[78] Also he argued that disindividuation constitutes a necessary process that must enter into relation with individuation in order to reach the formation of the transindividual, following this sense, it would indeed enter into relation with the meaning of the concept thought by Simondon in the first part of his doctoral thesis.

nor possibility of a pursuit of individuation" (Stiegler, 2011, p. 96). This seems to be eminently dangerous. The theater of being (an ontogenetic theater of coming-into-being) where the authentic properly singular becoming is revealed becomes liquidated into a *becoming-herdish*[79]. Why is disindividuation potentially so dangerous? The lack of becoming, (that is, when psycho and collective individuation lack of an individual milieu able to be supersaturated with potentials in order to individuate) can have the force to lead, according to Stiegler, to the reviving of authoritarian systems: "all these extremisms [...] leads herds of being to lack of being [*en mal d'être*] and to lack of becoming [*en mal d'avenir*]. Such inhuman herds will have a greater and greater tendency to become *furious"* (2011, p. 106), this means a greater tendency to channel the horde's libido into *bestiality* (2014, p. 60). The outcome between individuation and disindividuation is, like ontogenesis itself, a continuous weaving and unweaving oscillating between both tendencies. Opposes tendencies actually compose (2014, p. 73), they co-individuate.

The destruction of individuation leads to the problem of *desire* and the drives, that is, to the liquidation of desire or "disbanding" [*débandade*][80] as forged by Stiegler. *Desire*, as the very energy potential and as the very impulse of social energy (*philia*), *bears the force to compose (Eros) or decompose (Thanatos) an entire civilization*[81]:

> This situation occurs at the end of a process consisting in a *sequence of diversions of energy* leading to a *decomposition of this energy*, that is, to death -psychic and collective, symbolic and economic, and appearing as disindividuation, disaffection, and withdrawal [*désaffectation*]" (Stiegler, 2014, p. 66)

[79] Disindividuation, while in relation to the *loss of individuation*, differs from it. The former is primarily based on *becoming-herdish* while the latter supposes an attitude, a motivation, a push towards *becoming-insignificant.* In his work, *Acting out*, Stiegler explained: "everything seems to be organized to encourage the attitude in which insignificance dominates, or even a-significance. This is what I call the organization of the loss of individuation" (2009, p. 32).

[80] The concept of *débandade* can be traced in his works *Acting out* (2009 [c. 2003] and in *The decadence of industrial democracies* (2011 [c. 2004]). As highlighted in the first, the concept takes up Freud's use of libidinal energy in order to account for the loss of unity and disintegration at the level of individual and collective individuation.

[81] Civilizational tasks in the sense of a transformation of the libido are foundational in the works of Freud and Marcuse. The former particularly in: *Beyond the Pleasure Principle (1920), The Ego and the Id (1923), Civilization and its Discontents (1930).* The latter particularly in *Eros and Civilization (1955).*

We shall now turn aside, for a while, to notice that while Stiegler remains outmoded in his technological analysis (since he focused more on the social impact of television rather than on today's sophisticated algorithms as we already wrote elsewhere), he recognized, nonetheless, that this phenomenon is essentially computational. This does not suggest that Stiegler became rather a pessimist on technology as he himself warned to his critics (2011). Nothing could be further from the truth. It is because he himself was a critic who regarded technological processes as decisive transformations (*phase-shift*) for psycho-social evolution, (that is to say thinking and technological milieu as composition) that he attempted to warn *not about the risk of technology but of culture industries turning technology itself into the exactly opposite force of individuation.* To confirm this he wrote: "cultural and cognitive technologies could and should be placed into the service of an elevation" (Stiegler, 2014, p. 12) but rather, "cultural and cognitive technologies are being put to work in a hegemonic way, a way that is exclusively and systematically oriented towards disindividuation" (Stiegler, 2014, p. 28). This is the very reason why individuation became a cultural-political concept by definition while opposing the death-drive rising up against civilization (Stiegler, 2011, p. 108). Hence, "All individuation is a combat. All politics is a combat. All existence is a combat", diagnosed Stiegler (2011, p. 47). This growing process of *psycho-social homogenization* driven by the *technologies of the unconscious* will be discussed in more detail in the following section.

Now, in order to understand the liquidation of the process of psychic and collective individuation in Stiegler[82], we must review, in the first instance, its three different meanings. The first meaning assigned to the term dis-individuation consists in its social and gregarious aspect, that is, that which characterizes the collective. The second responds to the liquidation of forms of knowledge, and in particular, of theoretical knowledge in the face of the growing process of the power of the financial industry over all other domains. And the third meaning of disindividuation implies the shift of individuation towards its own transformation, here Stiegler associated individuation as rational knowledge and disindividuation as that which serves stupidity but is needed for articulating psychic transformation itself. In a certain way, disindividuation is neither a purely individual nor a purely social psychic instance but a process articulated by that domain called "I" or "Ego" (the narcissistic structure) that is feasible to be found at the service of psycho-technologies.

[82] In the attempt of unity (in-divisibility) from the *I* to the *we* lies the central node of psychic and collective individuation since both share the same preindividual funds while opening to transductive processes. This passage to unity is thoroughly developed by Stiegler in his work *Acting Out* (2009 [c. 2003]).

As opposed to Simondon, Stiegler did not emphasized in disindividuation in terms of a process activated by emotions towards the collective where superior individuations are produced but rather the opposite: it entails irrational and de-sensitized processes towards the destruction of the very superior phase of individuation. Disindividuation in Stiegler is still more outrageous than that: underlying disindividuation lies the kernel of the *new psycho-social production* as *incapable of elaborating and differentiating its own desires,* incapable of individuating, that is, the very failure of "taking a form" (Sect., Part I). Collective dis-individuation implies, for him, the destruction of the social body itself while engendering "disaffected psychic and social individuals" (2013, p. 7). The next lines are one of many examples of disindividuation at play:

> This generation[83] feels it has been downgraded firstly because it feels that *it lacks fathers*, and is thus deprived of the possibility of elaborating its desires, cast instead into the drives incited and exploited by the factory of nightmares and desensitization that the society of the spectacle has become [...].
> Progress (the *Aufklärung* understood as progress of reason) in this way inverts its sign [...] through which reason leads to unreason, progress to regression [...]. Hence regression forms a cocktail of ingenious stupidities brought about by cultural consumerism. In a more general way, however, stupidity is a scar of desire – of which regression is precisely the return to its primordial stage, which is that of the drives (Stiegler, 2015, pp. 35, 44, 45, own former italics).

What becomes profoundly interesting in his argument is that "the lack of fathers or authority" (which is one but not the only cause of disindividuation) implies the lack of *mod*els (mother - *mod*er) and *patt*erns (father- *pater*) to aspire to or to follow, namely, the simple fact that doing-something has an order and a purpose in life[84]: the "*loss of authority that is also a*

[83] Stiegler referred to the modern young people who have become adults, also young parents, whom he called the "downgraded generation" [*génération déclassée*] born between the 1980s and the late 1990s.

[84] In reference to the figures who occupy the educational role, Bergson analyzed:

> We have formed the habit of deferring to our parents and teachers. All the same we knew very well that it was because they were our parents, because they were our teachers. Therefore, in our eyes their authority came less from themselves than from their status in relation to us (1977 [c. 1935] p. 9).

loss of spirit turns out to [...] increasingly engender *the opposite* of that for which they were intended, in extreme and totally irrational forms"[85] (Stiegler, 2013, p. 6). This is another expression of the *simulacra* (Sect., Part II, Chapter VI, § 2.), what Deleuze calls the subversion "against the father" (1983, p. 48). The simulacra, unlike the copy, bears no resemblance to the model. This distance from the model (tradition-based models: political parties, trade unions, universities, governments, and the classic structure of the family) is not a distance in appearance

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That is to say, Bergson could clearly state that the educational roles came from their status and from their authority figure, while Stiegler, almost a century later, realized that this role not only does not fulfill the required authority or status, but *the parents themselves, do not even know that they should fulfill it.* Stiegler wrote:

> This downgraded generation does not feel that it received attention from the kind of responsible parents [...] On the contrary, they feel that they lack the means to become a generation of responsible parents, because they were themselves abandoned by their own parents (2015, p. 35).

[85] Behind this *disindividuation* a greater rupture is revealed, perhaps, *initiated in the French May 1968*, but which exceeds this space and cannot be covered here at greater length. Shortly expressed, this implies *a rupture against any figure of authority* or institution unified under centralized, tradition-based organizations, among these: political parties, trade unions, universities, governments, and the classic structure of the family. As a counterpart, what is characteristic of 1968 is the emancipation and awakening of the liberation of pleasure and instincts (Stiegler, 2014, p. 2). As a consequence, that "revolution" did not mean a change of political paradigm but a cultural one. For Stiegler, as he wrote in the second volume of *Mécréance et Discrédit,* May 1968 is the consequence of post-industrial and post-modern *marketing and ideology* united to ultimately achieve the desublimation of all kinds of authority and at the same time make societies of control more flexible (Stiegler, 2013, pp. 30-51). In the third volume of *Mécréance et Discrédit,* he emphasized on this very important topic:

> The convulsions of 1968 were [...] the first political, economic and social symptoms of capitalism's loss of spirit, which consists in a process of desublimation whose effects are being felt to their full extent as the destruction of spirit by capitalism (Stiegler, 2014, p. 2).

This not only implied that the process of desublimation would be an engine of capitalism's own destruction and disindividuation (disaffection and dis-affectation), but that in that very process, *while* destroying capitalism the new leftism born from May 1968, still is trying to constitute itself, by means of its values, as the new spirit of capitalism: "«artistic critique», liberty and authenticity that characterize the «values» of 1968. These values, coming from «leftism, and especially the self-management movement» tried to constitute a new spirit of capitalism" (2014, p. 19). The author strengthened this paradox: "the activists of 1968 imagined they were fighting capitalism, whereas in reality they helped it evolve" (2014, p. 32).

(*apparentia*) but a moral distance. A conversion to the simulacra is the loss of moral existence as a whole (Deleuze, 1983, p. 48).

Differently to irrationality and to madness, *sense* is conservative, it demands logic, an ordering, a realignment with structures of *λόγος*. In a networked and atomized society where tradition based models are being replaced by digital models (brought by/ recommended by algorithmic mediation), a more organized view of the cultural elements at play has become more than necessary. In the search for such an order, Stiegler himself took heart by putting French postmodernism and poststructuralism in check[86]:

> These questions – sovereignty, minority, majority, reason and even history – no longer seem to be posed in these terms, as if what is referred to as «postmodernity» had emptied them of content. [...]
> The critique of reason insofar as it can engender unreason was the very object of what eventually came to be called «deconstruction»: this way of philosophizing [...], inevitably tends to engender its contrary [...] as if the fate of post-metaphysical philosophy was to become foolish [...].
> And one wonders if, ultimately, this poststructuralist period, including Deleuze and Foucault as well as Derrida and Lyotard [...], did not sometimes constitute, rationalize and ultimately legitimate this backwards step, this withdrawal and this regression (2015, pp. 3, 74, 75, 78).

There is every indication that Stiegler detects in postmodernism the models of subjectivity that might be functional to the systemic stupidity created by global networked structures (hyperindustry). The cause of regression (destruction of critical thinking) is not based on the technology on which these structures are supported but the regression to unreason proceeds through the systemic organization of models of behavior targeted for consumption and prediction. The context of digital networks, regression, and atomization contain, by addition, something else, as described by Hui and Halpin (2013): "Bernard Stiegler would hold that these constructed social atoms are not actually «individuals», but disindividuals, as they seem to have lost their ability to act out except within the apparatus of an atomistic social

[86] On the similarities presented between consumerism, postmodernism, and the consumer society, Cf., Featherstone, 1991; Bauman, 1992; Baudrillard, 1998.

network" (2013, p. 4). When considering the mapping of interactions in social networking, they wrote:

> [T]echnological individuation within digital social networking easily slips back into disindividuation. Can we think of a new kind of individuation that neither glorifies nor rejects the possibilities of digital social technologies? A model of individuation that can be therapeutic to the current disindividualizing concept of the social presupposed by networks - and socio-technically engineered by them in practice! - is precisely what Gilbert simondon proposed in his book *L'individuation psychique et collective* (Hui & Halpin, 2013, p. 8)

However, no one seriously rejects (in theory and practice) the well-use of digital technology and its derivatives. The assumption that leads to dis-individuation (as understood by Stiegler) is not about subjective opinions regarding technological preferences, but rather, its obsessively servile aspect and its commodification of life itself: "When everything becomes a service, transindividuation is totally short-circuited by marketing and advertising [*la publicité*]. Public life is then destroyed: psychic and collective individuation turns into collective disindividuation" (Stiegler, 2013, p. 86). The process of disindividuation is, in these terms, but a *becoming-herdish*, a complete decomposition of singular identity at the psycho and social levels: "The loss of individuation results from the hyper-synchronization that follows from the becoming-hegemonic [...] from the elimination of that diachrony that is singularity" (Stiegler, 2011, p. 95)[87].

An emptied-out, atomized, relativized, secularized, devoid of moral values and des-individuated human being implies that its identity is granted only by the hedonistic consumption

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[87] Although it may seem self-evident, it is not a simple task to explain the reasons of why advertising implies a negative discharge in the processes of individuation (the decline and impoverishment of the human being's potentialities). Its association with deception, persecution, manipulation, and mystification orients it, in principle, towards the problem of *veracity*. Daniel Boorstin, in his work, *The Image* (1962), pointed out that this is not due to the advertisers' desire to deceive but rather to the public's desire to be deceived (Baudrillard, 1998, p. 127). Baudrillard openly opposed to this, that is, the association of advertising with cynical manipulation and expressed:

> Advertising is prophetic language, in so far as it promotes not learning or understanding, but hope. What it says presupposes no anterior truth (that of the object's use-value), but an ulterior confirmation by the reality of the prophetic sign it sends out (1998, p. 127).

in the grip of a fast-paced *image-culture*. When the behavioral model is not operated or modified by means of shared values within a community but by hedonic irrationality (*ἀνόητον*), by the delight of consumption, *we find ourselves in the presence of a world without destiny, and therefore, without history*, or as Stiegler noted "the liquidation of the kingdom of ends" (2013, p. 7). If, since modernity, the gods have been forced with the destiny of their death, the possibility of that destiny has even been removed from us. There is no longer history nor destiny (*the logic of time* in Spengler's words) since there is no finality (τέλος [*telos*]) either. There is no longer a destiny but models to manage, personalized, and predict destiny itself.

Accompanying both the Hegelo-Kojevian and also the Heideggerian perspectives, Giorgio Agamben, points to the passage from *historical existence* to the *personalized existence* of culture: "The traditional historical potentialities - poetry, religion, philosophy- which [...] kept *the historico-political destiny* of peoples *awake*, have long since been transformed into cultural spectacles and private experiences, and have lost all historical efficacy" (2004, pp. 76, 77, own italics).

Different from this, critical thinking was capable of criticism because it was the bearer of a *historical sense,* namely, it could make sense of the basic question: *where are we heading?* As a paradigmatic case, the production towards the posthuman and transhuman (which would indicate the death or "enhancement" of the human) is typical of an atelic (*a-telos)* world. Behind the strong intellectual demand for *the homo technologicus* hides the tragedy of the human itself. In the realm of the simulacrum, the posthuman is sovereign.

> The man who wants to dominate his peers calls the android machine into being. *He thus abdicates before it and delegates his humanity to it*. [...] In order to retreat behind it without anxiety, freed of all danger, exempt from all feelings of weakness (MEOT, 16, own italics).

Who travels the earth without a destiny? Nietzsche's *wanderer*. The *wanderer* is one of the aphorisms gathered in *Menschliches, Allzumenschliches* (1880) whose travel is without adherence to "any individual thing", with no fidelity to any situated-culture. What more than a century ago was a sign of freedom, has become a trace of detachment (*des-arraigo*). Han, in his book named *Hyperculture* (2022), optimistically uses the tragic thinker's aphorism as representative of today's culture:

> Nietzsche's wanderer walks about in a de-teleologized, de-theologized, that is, in a de-sited world. [...] The new journey has no ultimate destination. This absence of a telos, however liberates the wanderer's vision. [...] He distrusts the myth of "depth" or "origin". [...]
> His path is a *via dolorosa*, which, as he had to do without "God", only became more arduous, more painful (2022, pp. 74-76).

We may fairly gather, then, that the desacralised path, a path without strong ties to the previous "patterns of culture" (exercised by sense, tradition, and intergenerational customs), a path without history and without any rootedness leads inevitably to nihilism. This has been already prophesied by Nietzsche for the next two centuries: "What I relate is the history of the next two centuries" (Nietzsche in Stiegler, 2011, p. 53). Stiegler takes up precisely this thread to combat[88] the becoming and movement of life itself (individuation) to the nihilistic decadence that exhausts all possibility of singularity and transforms it into *becoming-herdish.* Hyperculture reproduces, with the misuse of technological means, humans without identity[89], moldable to a becoming uni-form, to a becoming-homogeneous, to a becoming-consumer. Hyperculture, in the context of post-industrial (Lyotard, 1979) and hyper-industrial (Stiegler, 2004) societies can not ascent out, it is but a manifestation of *mass weakness:*

> The ordeal of nihilism is as *such* that *massive weakness* that threatens force, and *where becoming is a becoming-weak*, a *becoming-base,* that is, the becoming-*hegemonic* of a tendency that tends to annul, *through its mass* [...] nihilism is the name of this de-composition, and this is what the thought of affirmation *combats* (Stiegler, 2011, p. 53).

2.3. Cognitive technologies and *hyperculture:* general problems

Today's hyperculture is characterized by Han as: boundl-ess, site-less, de-distanced, de-naturalized, de-theologized, de-teleologicized, de-internalized, de-rooted, de-sited, dis-persed.

[88] In this vein, Stiegler wrote: "We must compose. But we must not compose regardless of the price. We must at times oppose. And in order to preserve those whirlpools that are individual singularities, without which no individuation processes could occur, we must oppose more than ever" (2011, p. 119).

[89] This discussion continues some paragraphs later.

Such a picture represents a complete hydra manifestation, an amalgamation of isolated cultural features that can be combined in a boundless and siteless manner, and most of all, hyperculture is not guided by a culture based on values and tradition as we already explained. What all this foreshadows is that our contemporary hyperculture or as what Stiegler referred as "culture industry"[90] fails to bear the unifying force as ideally thought by Simondon in his ecumenical project of technical-culture, it rather separates (*schizo*) to a greater atomization while creating indefinite identities everywhere else. When reflecting on the implications of pattern recognition in culture, Steyerl wrote: "contemporary computation is not about confusion of identity but multiplication of identities" (2019, p. 12). This is obviously nonsense. It is self-explanatory that increasing (multiplying) the amount of identities drives the path towards confusion. The need of hyperculture for multiplying and reproducing identities mimics the behavior of the destructive impulses of the consumer society.

The loss of identity and the conversion to many possible identities, as able to be fashionably consumed and exchanged, can drive towards what Fromm called the *automatization of the individual* whose insecurity and doubt prompt the individual "to seek his identity by continuous approval and recognition by others" (1941, p. 206). This is not the same as belonging to "social patterns" which implies the individual integrated into a social group with common ideas and values and which enriches the individual by offering a feeling of belonging and, therefore, mental integration (1941, p. 19).

Just as the desire to buy is symbolically stimulated[91], industrial culture stimulates the desire to multiply, to atomize in order to re-arrange it into *profiled behavioral models*. Identities are now successfully organized, packaged, and distributed as bottled products and distributed by social media platforms[92]. *Des*individuated individuals hold branded identities which are algorithmically sorted out. This is cultural and political engineering at the greatest level.

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[90] See, footnote 77.

[91] Freud's double nephew, Edward Bernays, pioneered this as also noted by Stiegler. For example, by inserting the Philip Morris cigarette as a (phallic) symbol of freedom into a woman's mouth. This event was not only an unprecedented advertising success but also generated the unconscious bound between the element of cigarette consumption and the psychosocial element of freedom. Cf., Stiegler, B. (2011), chapter 3. Also see, Samuel, L. (2010).

[92] Media as identity provider is already found in the mass media theorists C. Wright Mills (1959): "The media tell the man in the mass who he is - they give him identity; they tell him what he wants to be- they give him aspirations" (Mills in Tudor, 1999, p. 22, translation with modifications).

Now the problem does not lie in creating fixed language categories or patterns to designate or distinguish one feature from another, such a limit becomes necessary for common signifiers in organized societies. Cassirer, again, holds good: objective reality can be described as the access to language, as that "common world" through which the individual opens up to a new phase of symbolic-consciousness. Nonetheless, as Xavier Guchet observes, there is a similarity between the philosophical foundations of Simondon and that of Cassirer which implies an *objectification* of the living with the world as a result of the creative dynamic of the unity of man (*l'unité de l'homme*) and of the real as opposed to the already determined contents and structures (2010, p. 15). That very unity is precisely to be found in cultural forms, for example: myth, religion, language, art, science, and others[93].

From social and language conventions not only cultural objects are born, also, it is possible to affirm that mathematical models arise from those conventions (Restivo, 1992). Similarly, when modeling patterns of culture, increasingly intertwined with the computational formation of mathematical patterns, these patterns of culture are equally the product of the dominant views belonging to symbolic and social conventions. As early as 1951, Talcott Parsons, in his theory of action, focused on the central importance of patterns in the construction of cultural systems: "A cultural system is a pattern of culture whose different parts are interrelated to form value systems, belief systems, and systems of expressive symbols" (1991, p. 55). A similar observation was taken into account from the field of cultural studies by Raymond Williams when reformulating the abstract notion of *patterns of activity and value* into the actual "structure of feelings"[94]: "What we are looking for, always, is the actual life that the whole organization is there to express" (1961, p. 49).

In other words, we are always looking for patterns of culture that allow us to make sense of our models of reality. Through cognitive technologies, such as machine learning, we can appreciate the next stage or next scale in the evolution of the patterns of culture. And this is because, while continuing to shape culture as a system, these patterns are no longer created,

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[93] This is how, Guchet, greatly summarizes it:

> The human being is the only being who has been able to objectify his relationship with the external world and each cultural form (myth, religion, language, art, science, etc.) is defined by the nature of its own power of objectification of experience and the world (2010, p. 15, own translation).

[94] This concept has been described in Sect., § 1.

manifested or transmitted solely through human agency. Still, the major difference between the human manner of manifesting patterns from the computationally automated manner lies in the fact that, for automated systems there are no collected "facts" but conventions and trends that, although they may respond to specific contexts and cultures, in a very large dataset, they become indistinguishable from each other. *Machine learning mathematizes culture*, turning it into a sea of abstractions whose relations are purely virtual.

The deficit of philosophy becomes at this point a vital threat to culture. This had already been warned by Cassirer both in "The concept of philosophy as a philosophical problem" included in *Symbol, myth and culture* (1935-1945) and in *The logic of the science of culture* (1991): the renunciation of the fundamental duty and function of philosophy with respect to objective theoretical truth and objectivity in Western thought implies *the loss of true contact of philosophy with respect to the world.* For Cassirer, this derives in the idleness and inanition of philosophical thinking, but for us, it is even more outrageous than that: it paves the way to the lack of common sense and stupidity that characterize today's culture.

One would be well advised to heed the fact that remaining, at least at some extent, conservative in language categories aims for the construction of objective reality[95]: "a common understanding of what is true, and what is not true, is important for the constitution of an objective reality, that is, a reality based on intersubjectively negotiated norms and rules" (Apprich, 2019, p. 108). These intersubjectively codes that constitute while being constituted by social conventions and institutions are not recognized by subjective interpretation nor by the reduction of a dominant ideology (one of the most fashionable arguments nowadays) but by what Durkheim called collective consciousness (*conscience collective*): an organized system of agreed and shared social standards and conventions. Behind this, is what Parsons recognized as "common culture" or "symbol system", i.e., a common system of symbols, actions, or gestures that allows interaction by "more or less the *same* meaning" (Parsons, 1991, p. 105) and what Raymond Williams presented in terms of "materialized patterns":

> Over an active range, the patterns created by the brain and the patterns materialized by a community continually interact. The individual creative description is part of the general process which creates conventions and institutions, through which the meanings that are valued by the community are

95 Nonetheless, "In real life, things are not true or false, but have grades of truth: «if X is a bird, X can fly», is mostly true but not always" (Alpaydin, 2021, p. 62). This is why, explains Alpaydin, fuzzy logic coming from expert systems were replaced by machine learning, because they can deal better with uncertainty.

shared and made active. This is the true significance of our modern definition of culture (1961, p. 38)

What is even more, such a pattern-based structure "transmitted through a symbolic medium, such as a language" implies the adult's duty for the "transmission of the reality principle as a formalized and encoded accumulation of intergenerational experience. [...] [T]his intergenerational relationship constitutes the formation of *attention*, constructed *retentions*, which then create *protentions*, that is, expectations without *attention* is impossible (Stiegler, 2010, pp. 7-8). These arguments have a ripple effect. When language categories based on objective reality (facts) or categories based on a community of consensus and codes (based on common value-orientations or patterns of culture) become controlled, rearranged, and automatized by computational variables, the result turns into a growing complexity.

As we know, many of the attributes belonging to patterns of culture become improperly correlated and generalized to the cost of the reduction of reality itself. This has several implications. A considerable amount of privacy legislations[96] research and practices have been successful in correcting some of these limitations. Still, it is acknowledged that general assumptions on data are necessary for the algorithm to proceed, this takes the name of *inductive bias* also known as *learning, modeling or selection bias* (the design of the algorithm's preferences), *sample bias* (the process of data selection). "[W]ithout a learning bias there can be no learning, and the algorithm will only be able to memorize the data" (Kelleher & Tierney, 2018, p. 144). Yet, from targeting or correlating specific attributes belonging to a category (e.g., ethnicity) to certain event outcomes (e.g., prediction of criminal activity) is how distorting patterns are born[97] (Favaretto, De Clercq, and Elger, 2019).

[96] For example, the Fair Information Practice Principles (1973, United States), Data Protection Directive (1995, EU), General Data Protection Regulations (EU, 2016), Guidelines of OECD (1980), APEC Cross-Border Privacy Rules (CBPR) System (Asia-Pacific, 2004).

[97] When distorting patterns are born, culture, through digital platforms, assumes the role of virilizing, reproducing them. The problem has thus become an effective reality with political consequences, for example, by the widespread adoption of cancellation policies (cancel culture) or the injection of multi-million dollar donations and campaigns for one particular cultural feature (identity politics). The political system together with culture, as a whole, as it is worth emphasizing, no longer respond to traditions, shared intergenerational experiences, and formed values, but to a continuous exploratory practice of processing and combining isolated patterns of culture.

Patterns have a viral logic, they only seek to reproduce, propagate, and be seen everywhere. In the light of these insights, Han's claims might hold a naive optimism completely missing the analysis of patterns in culture:

> Hyperculture does not produce homogenous, monochrome, uniform culture. Rather, it triggers increasing individualization. Individuals follow their own inclinations, cobbing together their identities from what they find in the hypercultural pool of practices and forms of life. In this way, patchwork structures and identities emerge. Their multicoloured nature points towards a new practice of freedom (Han, 2022, p. 52).

Hyperculture is the culture of the *average* (the mean in statistical distribution) disguised as multicolored diversity. Hyperculture fakes freedom and feels immersed in a "pool" of cultural features able to be combined like a patchwork (again the multiplication of identities). Such a culture, or hyperculture, has become anything but a profound and tense battle of patterns in the struggle for self-perpetuation. This becomes highly problematic if we agree on the claim that culture shall be "above all a repository of value" which implies that "humanity's most significant beliefs and achievements are articulated and «stored» in culture" (Tudor, 1999, p. 23).

The elements developed in *hyperculture* take their structure from the events and facts of *hyperhistory* whose medium is the *hyperspace* of computer networks. We are in the *hyper*, because we have lost contact with what is down here, with the ground (earthy) and its sensory perception. We are no longer «in the presence of» anything. Han here certainly hits the right point: "Today, our perceptive apparatus itself is incapable of arriving at any conclusion: it just clicks its ways through the endless, digital net. Our senses are completely distracted" (Han, 2017, p. 71). Virtual home is an oxymoron. Time has been liquidated and presence has become absence.

> It also is worth highlighting that, on the other hand, and at a different level, we witness industrial societies becoming without history. In a certain sense the entire problem points to a global disappearance of historicity in a kind of globalised advanced industrial society, the model of which seems to be a mechanical pendulum «without memory» (Bardin, 2015, p. 212).

Simondon's specialist, Andrea Bardin, updates through Canguilhem (1955) who took up from Bergson (1932) the image of society as a "pendulum endowed with memory". Memory is the regulative aspect of temporal events, those knowledge and habits that, following Bergson, *enrich* the "social milieu" (Bergson, 1932, p. 24 in Bardin, 2015, p. 212) while giving place to a civilized society[98]. Memory (anamnesis, *ἀνάμνησις*) is the psychic reconstruction of past events, and the course of past events belongs to history itself. Notably, Graham Harman, defines the concept as follows: "Anamnesis means recollection or reminiscence, the gathering and collecting of what has been lost, forgotten or erased" (Harman, 2009, p. iii).

The process of gathering and processing data in the most efficient possible way requires taking into account (as we explored in Sect., Prolegomenon, Chapter II, §2, 2.1., and along Part II): the limitations of time (computing power) and space (storage memory). The increasing data-processing due to the computational power exceeds the processing of human memory and its ability to give structure and sense (*Sinn*) to past events. This excess lacks, as rightly pointed by Han, of a narrative as such:

> Storage and retrieval are fundamentally different from remembering, which is a narrative process. [...]
> Memory constitutes a dynamic, living process; here, different levels of time intersect and influence each other. Memory is subject to constant rewriting and rearrangement. [...]
> Digital memory consists of indifferent - as it were, undead - points of presence. It lacks the extended horizon constituting the temporality of the living. Digital temporality belongs to the undead. (Han, 2017, pp. 67, 68).

History is the cause of human decision (Bauman, 2000, p. xv), hyperhistory is the product of an anamnestic automated pattern-based culture. Hyper-history as well as hyper-culture imply an excess, they are beyond history. This does not eliminate or diminish anything human alike, we have already made a critique on this (Sect., Prolegomenon, Chapter I, §1. , 1.2.), but rather, it rearticulates the system of pattern creation, and therefore, the space of experience within the psycho-social universe. A few lines back we wrote two primary causes that reveal the absence of history: first, the ever-increasing amount of data that leads to the

[98] For Bergson: "A society may be called civilized when you find in it such a power to lead and willingness to be led" (1977 [c. 1935], p. 171).

impossibility of reconstructing schemes of sense throughout memory, i.e., what Bardin in the quotation above points out: a globalized society without memory, and second, the appearance of a world without destiny (*télos*) as we also previously addressed. We shall explore the latter in more detail.

When referring to automated learning mechanisms we repeatedly take the probabilistic prediction of the future for granted. The scholar Florian Cramer even expresses that data analytics tries to solve the divinatory problems as the priests of the Delphic oracle, namely, how to make sense of the endless stream of data (Cramer, 2019, p. 23). Still, in the technical dimension of machine learning, *prediction and future* are not necessarily related, it rather refers to predicting missing values of an attribute (Kelleher & Tierney , 2018, p. 2). At a more philosophical level, the dataset empty precisely the meaning (*Sinn*) itself[99]. As Han points out: "Dataism is nihilism. It gives up on any and all meaning. Data and numbers are not narrative; they are additive. Meaning, on the other hand, is based on narration. Data simply fills up the senseless void" (2017, p. 59). An existence based on data and not on narratives is meaningless, the same occurs at the global scale, a society based on data has lost its historical sense, and with it, also its destiny.

Now, what does it mean that there is no longer destiny? It means that there is no more creator of the future. The automation of behavioral models is placed at the dawn of a subject that never has to go in search of its own future because everything has already been automatically recommended, predicted, and treated beforehand which also includes a "highly precise voter profiles result" (Han, 2017, p. 62). The fact that this subject -never has to go in search- means that its will *(voluntas)* has finally been diminished.

Automated technology exposes the bind we find ourselves in; the choice or will to choose[100]. In a very neoplatonist take, Stiegler wrote: "the noetic soul feels that, deprived of its premier faculty, thought, its capacity to discern and therefore to anticipate, and to *want and act knowingly,* is *radically threatened*" (2013, p. 4). On this very problematic, in relation to machine learning, Roberge and Castelle greatly explained: "Anticipation, expectation, the manufacturing of choice, and informed trading on outcomes all become part of a spiral in which

[99] For Stiegler, this is even more radical, calculation cannot foretell the future because it is essentially indeterminate, he expressed, if future is to be calculated it remains only as a consequence of the present which is no longer future (2013, pp. 68, 69): "The future, as that which *breaks* with the present, that is, with what exists, is *already always projected onto another place,* one *which does not exist* and which, as such, remains incalculable".

[100] As in a simple way, Evgeny Morozov, illustrated: "Here is modernity in a nutshell: We are left with possibly better food but without the joy of cooking" (2013, p. 11).

the future's indeterminacy is generated, managed, and potentially conquered" (2021, p. 15). The field of indeterminacy is the very settlement of any decision.

Is it possible to illustrate something beyond the "reign of spiritual misery" as described by Stiegler? Is it possible to make a convergence between practices of technology and sacredness as explained at the beginning? Understanding the latter as the civilizing work of trans-formation, of re-enchantment of the spirit, a re-encounter with the cosmos and with the infinite potentiality of the noetic source (thought itself) brings about a redefinition of the human that has nothing to do with the post or trans-human, but with a redefinition of the critical spirit (and therefore, its autonomy and freedom). This shall imply a new epoch of the spirit, that is to say, of civilization. In Badiou's analysis of Deleuze, *The Clamor of Being*, he raises a cautionary remark about the "purified automaton", i.e., someone who is not the very source of his own thoughts and behaviors. Badiou writes:

> From there, one easily passes to the well-known theme of Kierkegaard: an authentic choice is never the choice of this or that; rather, it is the choice to choose, the choice between choosing and not choosing. Detached in this way from any particular stake, choice takes on the form of an «absolute relation with the outside (Deleuze, 1989, p. 177)» (Badiou, 1997, p. 11).

This incapacity of choosing in the face of choice itself bridges what Badiou stressed together with what Stiegler previously mentioned: disindividuation as the incapacity of the passage from potentiality to actuality[101]. The purified automaton is but purified from choosing. It is in a purely virtual or potential state not being able "to take form". Stiegler realized through his reading of Deleuze that in a state of disindividuation there is an "uninterrupted repetition" and that this repetition is precisely the condition of a mechanism outside the rational. This is very important. We write it again: repetition is a mechanism, which, when executed uninterruptedly, becomes automated. By repetition, we automate cognitive tasks such as that of

[101] What is interrupted in a process of disindividuation is the genesis itself. The process of genesis and its becoming responds to this mechanism of virtuality and its actualization:

> It is sufficient to understand that the genesis takes place in time not between one actual term, however small, and another actual term, but between the virtual and its actualisation- on other words, it goes from the structure to its incarnation (Deleuze, 1994, p. 183).

driving a car. That is, once each step is repeated over and over again, we no longer need to stop for deliberation on each of the steps but we just drive the car in a rather thoughtless repetitiveness manner. Beyond deliberative thinking is automation itself. What is thrown out of the door of the rational enters now through the window of the thoughtless, of the *unconscious*[102].

> [B]ehind the questions of reason (actualized as rational knowledge and maturity) and unreason (stupidity and madness), which cannot simply be opposed, there lie the play and the role of the unconscious, which the *Aufklärung* was obviously incapable of thinking – the play of Light and Shade, Enlightenment and Darkness.
>
> [W]hereas 'French theory' failed to create much public debate around [...] the question of the Shadow, of shadows and of Enlightenments [...] at the very same time *psycho-technologies were being developed, making it possible to set up a psycho power that drew upon the discovery of the unconscious in the most pragmatic way possible*:
>
> • by establishing, through marketing, the global consumerist model, in taking control of behavioural models, that is, processes of transindividuation (Stiegler, 2015, pp. 71-72, own italics in the second paragraph).

After reading these last lines, we can recognize that Stiegler has seen the biggest picture of all: psycho-technologies (this liminal role of algorithms between the attributes of the world and the individual's attention) put into the tissue of discussion the dark zone of the unconscious. The expectation [*attente*] or attention is where the psychic individuation is constituted (Stiegler, 2013, p. 7). In other words, he referred to a tool of power (algorithms), which is purely technological and has the capacity to operate by pattern-repetition at the unconscious level.

In the book *Gödel, Escher, Bach*[103], Douglas Hofstadter observed something alike: "Computers by their very nature are the most inflexible, desireless, rule-following of beasts. Fast though they may be, they are nonetheless the epitome of unconsciousness" (1994, p. 34). Cognitive technologies (as called by Stiegler) or the technologies of the unconscious (as we

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[102] In favor of treating the unconscious in cultural studies, Erich Fromm noted: "Only a psychology which utilizes the concept of unconscious forces can penetrate the confusing rationalizations we are confronted with in analyzing either an individual or a culture" (1941, p. 137).

[103] As Jaron Lanier notices, *Gödel, Escher, Bach* is a book that "brought the digital perspective on life and the universe to the general public for the first time" (2018, p. 115).

call it) constitute the powerful operation at the computational level to give form to the patterns of culture (behavioral patterns, habits, interests, opinions, addictive mechanisms, and others). The technology of the unconscious is a repetitive, automated operation, whose greatest effect occurs wherever repetitive and automated processes take place. The disruption of cognitive technologies occurs at the unconscious level because they are able to capture: attention, fear, and desire (*configurational patterns* as called by Simondon and as we introduced previously). The real disruption of machine learning is but a psycho-technological and psycho-political one.

Back to Hofstadter's observation on the computers and the unconscious, the substantial question that takes off is the following: why in repetition, in automatism, in the search for the pattern there is an epitome of the unconscious (or *Imago*[104] as Lacan named it)? Behind every model or simulation of reality (unfaithful or deceptive copies of it) there are mathematical models at work. Bergson shares a sharp light on the idea of mathematics transcending our conscious realm:

> We must [...] have managed to extract resemblances from nature, which enable us to anticipate the future. Thus we must, consciously or unconsciously, have made use of the law of causality. Moreover, the more sharply the idea of efficient causality is defined in our mind, the more it takes the form of a mechanical causality. And this scheme, in its turn, is the more mathematical according as it expresses a more rigorous necessity. That is why we have only to follow the bent of our mind to become mathematicians. But, on the other hand, this natural mathematics is only the rigid unconscious skeleton beneath our conscious supple habit of linking the same causes to the same effects; and the usual object of this habit is to guide actions inspired by intentions, or, what comes to the same, to direct movements combined with a view *to reproducing a pattern.* We are born artisans as we are born geometricians, and indeed we are geometricians only because we are artisans (2005, pp. 50, 51, own italics).

[104] As Simondon recalled, Lacan called the unconscious representation *Imago*, that is, not an irrational decoupling from reality but an organizing structure (harmonization) of forces that appear as contradictory: "Lacan (volume VIII of the Encyclopédie Française) calls the paradoxical entity *Imago*, unconscious representation that is under the complex and constitutes one of the organizers of psychic development: the Imago organizes images and thoughts" (II, 127, own translation)

What Bergson exposes is that behind the code of nature (the patterns of ancestrality in our terms) there are mechanisms for the reproduction of patterns that are acquired by the mind consciously or unconsciously and executed by the law of cause and effect. After applying this "mechanical causality", reality (or the user's interface) becomes the result of the reproduction of patterns by resemblance or by repetition: "In considering reality, mechanism regards only the aspect of similarity or repetition. It is therefore dominated by this law, that in nature there is only like reproducing like" (Bergson, 2005, p. 51)[105].

As we have already mentioned, Stiegler analyzes repetition through Deleuze. However, in Deleuze (as different to what was addressed by Bergson) repetition does not necessarily lead to a pattern, on the contrary, repetition is repetition of difference and the ultimate depth of the real is to be found there. In other words, repetition is the ever taking-form, the mark of individuation itself[106]. Stiegler wrote: "For repetition (of which the I and the ego are instances) is what Deleuze thinks as the very question of the unconscious" (2015, p. 68). That is to say, repetition is the expectation, in Hume's sense, that things will continue to behave in the same way.

The slippery line of pattern creation in mathematics, pattern creation in automated technologies, and pattern creation at the unconscious level became more bound than ever before. Stiegler, in this way, gave an account of the key marked by Simondon: if *dés-individualisation*[107] is produced by the emotions (linking the individual to the group) and, in addition, if rational knowledge becomes inoperative in the face of systemic stupidity, technology itself will be the decisive drive of our century to activate or deactivate the individual's *potentia*, that is, its emotional psychological traits; its attention, desires, expectations. It is Stiegler who opened the doors to an analysis that remains to be fully defined regarding the concept of dis-individuation, which crosses the psychic-individual and the psychic-collective, that is, the structure where all patterns meet, the level of what we would like to refer as the *Meta-pattern*, that is: *Culture* itself (Sect., Chapter VIII).

[105] These are similar arguments to what we have worked on in the section of *patterns of ancestrality*. Sect., Prolegomenon, Chapter II, § 1.

[106] In the very process of evolution of both biological and technological mechanisms, there is what Kevin Kelly (2011) called "the hacking of life": a progressive process of differentiation and specialization over time, i.e., animate or inanimate feedback systems tend to move from a general and undifferentiated state to increasingly specific functions.

[107] These arguments become more clear in Sect., § 3.

§ 3. *Des*-individuation as a cultural-political tool

Pattern-based technology is already a psycho-political reality. The meaning of the political is absolutely traversed (*durchgebrochen*) by the virtual (digital) environment, an ever-increasing number of actions, relations, behaviors have their fingerprint there: "In the 21st century, the digital is political" (Susskind, 2018, p. 6). But the digital is not political because it is the most important means for any action, it is political because in the automatization of data in the digital milieu the *emergence and conservation of patterns of all possible cultural tendencies* take place. The digital is political because it is possible to recognize, create, manipulate, distort, or even destroy patterns and tendencies of behavior, choices, opinions, actions within it. It is not only political, it is psychopolitical.

Machine learning or mathematical automation is more than applied mathematics and data compression, collection, cleaning, analysis and correlations, it is a mode of gathering, of formation, production and reproduction of the patterns through which the subjective and cultural reality of the 21st century is in-formed, shaped. Contemporary AI progress, based on the pattern-matching logic, does not tend towards process of individuation nor is led by technical objects which need to be integrated within culture as a means of accomplishing the political and cultural simondonian project, that is: the "necessity for a culture of technics" (MEOT, 81). On the contrary, as Hörl (2015) already recognized some years ago, they already are at the very heart of culture and what we shall develop, instead, is a reverse tendency, the tendency of des-individuation, shaping a new type of society and culture, pattern-based, form-based, *eid*etically-based. A new techno-cultural project shall be that of *pattern awareness*.

What types of automated patterns can be considered as representative of today's culture? To approach this we shall first understand what patterns imply in the traditional sense of culture as analyzed by Benedict (1934) and Williams (1958), namely, those patterns given solely through human sense and agency. Patterns analyzed by them imply patterns in cultural tradition which invoked traditions, rites, ceremonies, customs (e.g. marriage), beliefs (e.g. religious), social values (e.g. type of authorities and education), symbolisms (e.g. through music and art), and many others, which, according to each culture, implied an adaptation of the individuals with respect to patterns belonging to their community and the continuous readjustment and transmission of those patterns to new generations according to their particular context. For Williams, the exploration of patterns of cultural tradition "confront us with the real nature of the choices we are making" (Williams, 1961, p. 53). Automated patterns in culture, like patterns in cultural tradition, confront us not only with a selection of attributes, but also with interpretation: "We tend to underestimate the extent to which the cultural tradition is not only a selection but also an interpretation" (1961, p. 53).

Automated patterns, however, do not respond to a system of values belonging to tradition and customs but are always configured around isolated features that express the behavior of the individual (according to variables such as: age, geographic location, consumer-type, belonging to certain groups, and others) in the context of communities more or less defined in virtual platforms. Hence, everything we have mentioned above about cultural tradition is now atomized to one's personal tastes and interests, ever-changing political opinions, the type of purchases, the type of online search, the time dedicated to each image or post, and many others. Hence, the algorithmic reward system feedbacks certain patterns that follow a trend not unique and particular to each individual but in line with so many other individuals whose behavior is also similar.

Does not this algorithmic automation and mediation of culture come at too high a price? If ancestrality, history and hyperhistory were to be understood as the propagation and struggle for the perpetuation of patterns through different *milieus*, the result we are moving towards is that of an ever-increasing automation of the patterns of reality (life, work, language) in its totality (culture). This is the culmination of a genetic process which is still in progress. There is no longer alienation through technology, but a new way of creating and reproducing patterns by other means. There is no alienation but stupidity (in Stiegler's sense), that is, not being aware of patterns presented in online platforms. *Stupidity is lack of awareness, lack of attention, lack of consciousness.* As Cassirer has well observed, this awareness is the true potentiality of the human spirit: "This becoming conscious is the beginning and end, the alpha and omega, of the freedom that is granted to man; to know and to acknowledge necessity is the genuine process of liberation that «spirit» [...] has to accomplish" (Cassirer, 1961, p. 74).

While, at-present, an increasing variety of behavioral patterns are being automated and growing in clusters of correlations and associations, the more inclined we are to the general patterns (models), the more uni-*form* the world-wide culture becomes[108]: "Variability in meaning construction and heterogeneity of culture and social practice [may be] thus effectively excluded from consideration" (Tudor, 1999, p. 30). This explicitly means that cultural features (those data collected from the online platforms and saved in great cloud computers able to form

108 This is because the same network content (for example, a TikTok video or a comment on Twitter) can be consumed in different parts of the world, leaving the field free for the formation of opinions and future decisions which are no restricted to a local group within a delimited region but opened to any subject worldwide.

a model of behavior) which are mathematically modeled can be at the service of a process of des-individuation, in the pursuit of the most intimate part of the psychic-collective and towards the path of pre-established behavioral models. The automated patterns of culture may enhance the evolution of automated patterns (transindividuation), but also, they may open the doors to des-individuation: a tendency towards the re-arrangement of features, the increasing indistinction of singularities and differences.

Rouvroy argues for automatization from an opposite view: "individual and collective individuations which are always deviations from known patterns and profiles" (2013, p. 145). This analysis assumes that individuation processes can be derived from the organization of patterns. This view conforms precisely the opposite understanding of the scheme proposed by Simondon, for whom individuation does not derive from structural equivalences (even less between the somatic and the psychic), but rather, individuation itself precedes and gives places to further structuring. In short, individuation might not be derived from extensive realities (patterns located in space and time). This becomes even more clear when Deleuze makes use of Simondon's notion of individuation: "It is notable that extensity does not account for the individuations which occur within it" (Deleuze, 1994, p. 229). Extension, contrary to Kant and in favor of Deleuze, is not a sufficient criterion to account for individuation. An algorithmically mediated society that standardizes stereotypical patterns by means of models tends not so much to individuation, but rather, to des-individuation.

It is a more simple task to name examples where algorithmic automation occur, such as: medical diagnostics, global services, court records, value chain and digital business, capital markets (algorithmic trading), geo-referenced data, autonomous vehicles, robotic logistics, consumer trends, mining and agricultural production, prototyped infrastructure, energy consumption, and many others. Yet, how to allude to patterns of psycho-social behavior in culture?

The analysis becomes much more complex because the patterns may respond to both tendencies: to cultural conventions of a specific local culture, as well as, to general conditioned human behavior. Lanier contributes in this regard: "User interfaces are about people, and people live out in the big unfenced world, and we can't specify them perfectly. So there's no way to achieve the same kind of learning curve" (2018, p. 123). Or as the mathematician Eugene Wigner long before wrote: "The world around us is of baffling complexity and the most obvious fact about it is that we cannot predict the future" (1960, p. 3). In other words, the most comfortable position is to keep the claim that the complex nature of behavior and the social and ethical values applied to this cannot be reduced to the patterns of mathematical models

(Cipresso, 2015; Cushing, 2013; Pucciaand and Levins, 2013). Another difficulty points to the fact that the complexity of human behavior is largely not traversed by the rational element: "Humans are irrational, inconsistent, weak willed, and computationally limited, so their actions don't always reflect their true preferences" (Russell, 2020, p. 32). However, the experimental-driven patterns of human behavior (such as Skinner's box or sensor-rich computers like smartphones) can today be examined under the dynamics of the virtual environment and processed computationally[109], that is, they can be treated with a greater number of variables at stake. Professor in quantitative psychology, Pietro Cipresso explains in this regard: "Virtual environments are particularly suitable for behavioral studies; in fact, within these environments it is possible to satisfy all the experimental requirements linked to the relational, dynamic, and multidimensional attributes that are the core framework of behavior" (2015, p. 3).

Recognizing and influencing patterns of human behavior on a large scale based on their digital footprint (for example, social media's likes) by means of automated algorithms is what is known as «algorithmic behavior modification» (BMOD) (Greene, et. al., 2022) or «digital mass persuasion» (Matz, et. al., 2017) or simply «personality prediction» (Roberts et al., 2007, Settanni et al., 2018, Gao et al., 2019, Stachl et al., 2020). This comes in the form of predicting actions (behavior) as well as psychological traits (Greene, et. al., 2022, Kosinski, et. al, 2013, Matz, et. al., 2017) through the use of personalized interventions (Zuboff, 2019).

> [W]e should not underestimate the potential negative consequences of the routine collection, modeling, and uncontrolled trade of personal smartphone data. For example, organizations and companies can obtain information about individuals' private traits (e.g., the Big Five personality traits), without the personality information ever being deliberately provided or explicitly requested. Mounting evidence suggests that these data can and are being used for psychological targeting to influence people's actions, including purchasing decisions and potentially voting behaviors, which are related to personality traits (Stachl et al., 2020, p. 17684).

The evidence of patterns at the psychological level abstracted from digital traces should not be isolated from the cultural system in context. The rearrangement of psycho-social patterns is not at random, nor does it conform to merely technical parameters based solely on the

[109] This possibility is what Lanier sees as the nightmare of virtual reality. Cf., Lanier (2018).

programmer criteria. For what we encounter is that psycho-social patterns constitute the very heart of culture. It is culture what transcends the diverse dispositions and multiplicities to achieve an ordering, a vision of the world with its ever-evolving pattering.

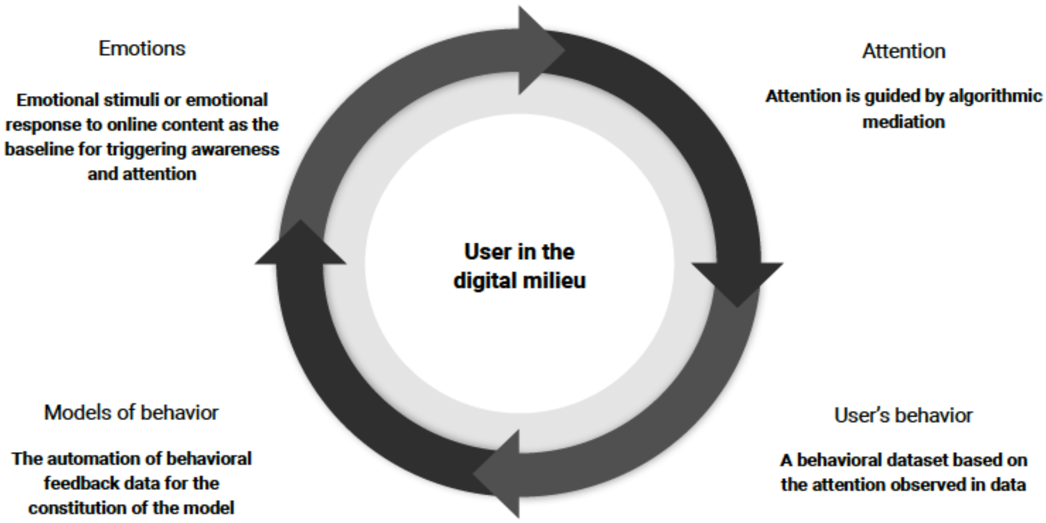

Figure 21. A psycho-social flow of behavior modification in the digital milieu

In this hyperhistorical time, to exist culturally is to exist within patterns that have been woven by the process of algorithmic automation itself. This counter-movement against individuation, namely, *desindividuation*, fosters a culture of symmetrical patterns (and not of increasing differences) whose image represents the most ecumenical political and cultural project of our time: "Above all, Big Data makes collective patterns of behavior visible. Dataism is augmenting *Zunehmen im Gleichwerden*, or hypertrophied sameness (Han, 2017, p. 76). This is precisely what Simondon called the «alienation of culture»:

> [C]ulture, in reality, is an initiation into the opinions of determinate social groups having existed in previous epochs [...]. It is really culture that has now

become a genre with its fixed rules and norms; it has lost its sense of universality (MEOT, 124).

Against the lost of universality in culture, there is the gain of universality by technology performed by the interrelation of diverse sciences: "Today the existence of a technics of information gives technology infinitely greater universality" (MEOT, 125) wrote Simondon when referring to the field of information theory. In this sense, it is precisely the field of machine learning that acquires the universal and integrative character of sciences of the most diverse kind as we explained in the previous section (Sect., Part II).

Now, when relating the alienating aspect of culture to machine learning, a culture fixed by pattern and models of behavior, we find that in his book, *Machine learners : archaeology of a data practice*, Adrian Mackenzie wrote:

> Populations of models are sampled, measured, and aggregated in the ongoing production of statistical realities whose object is no longer a property of individual members of a population (their height, life expectancy, and chance of HIV/AIDS) but members of a population of models (Mackenzie, 2017, p. 124).

This is correctly observed and especially, those models, as noticed by the historian of technology, George Dyson, are the product of tracking human relations in the digital environment which can be updated through a database (which, if maintained on a large scale, can turn out to be overwhelming). Dyson notes the implication of having such models updated in real-time: "The resulting pulse-frequency coded model of the social graph *becomes* the social graph" (Dyson, 2020, p. 39). And despite how overwhelming (time and space resources) can be to maintain a database of behavioral models, Russell points out that: "[T]here is abundant written and filmed information about humans doing things (and other humans reacting). Technology to build models of human preferences from this storehouse will presumably be available long before superintelligent AI systems are created" (2020, p. 31-32).

Today culture is neither sacred nor rational, as we extended on this before, Stiegler denounced it even as irrational and stupid, but from our view, although we agree on those arguments it also involves an ever evolving genetic process of automated patterns of behavior (models of: consumer trends, political agendas, lifestyles, reference figures (influencers), and opinions to follow). Automated models reshape culture entirely. Influenced by Bergson's reading, Simondon recognized the relationship between vulgar knowledge, the search for the similar and a tendency to static structures: “vulgar knowledge is a search for the identical throughout the endless fluidity of becoming, a refusal of movement on behalf of the static” (A, 670). What is “followed” and absorbs “attention” of users in the digital platforms is that which gregariously gathers that “many” followers. What is “followed” are patterns of behavior, modes of how-to-do and how-to-live. The (automatically recognized) behavior becomes part of a (more or less) precise model. “The self-perpetuating patterns that we call human beings are now dependent on clothes, cooked food, vitamins, vaccinations, credit cards, smartphones, and the Internet. And -tomorrow if not already today- AI” (Dennett, 2019, p. 44)

Is this a negative symptom of contemporary culture? It is of no interest to extend on the moral nuance here. It is, however, notable to remark a tendency proper to desindividuation, to a way of reconstructing or encountering the patterns of the world through a digital milieu. Having become individually predictable and having stopped the cultural processes of individuation (transindividuation), unfortunately, does not seem to be (cynically and frivolously) a malaise in culture that deserves importance or discussion today. Nonetheless, culture is conforming to the patterns and models pre-established by political and market trends, namely, a “global system of calculation” (Stiegler, 2014, p. 35). This does reveal matter for reflection.

3.1. The gregarious tendency

We shall briefly consider another very complex question that could serve to understand the problem of desindividuation and that is: what arguments allow us to claim that we tend towards the general, towards the copy of models, to follow (or to be persuaded) by automated patterns of culture? Or as Spengler, when looking for metaphysical structures behind the sense of all history (structure that, is worth to notice, was to be found in mathematics) posed the question: “is all history founded upon general biographic archetypes?” (1926, p. 3)

Before diving deep into the previous questions and claims, we shall not forget “how variegated a human world and its mental life are” (Freud, 1962b, p. 11), yet, we shall also not forget how alike the human world and its mental life can be. Regarding the latter, the diversity of reasons and nuances to explain the tendency towards the general mass behavior have been multiple, diverse, and multi-causal along history and social contexts. We do not attempt to be exhaustive in this regard. For Spengler’s question, the answer can be traced to inheritors of Plato, for example, such as Carl Jung, who considered that the cause of this is to be found in an archaic-mythological behavior: copying is about mental contents or psychic manifestations that rest on the archetypes (*Urbilder*) of the collective unconscious. That is to say, the gregarious tendency responds to the relation between the collective archetypical models and the psychic. The question about archetypes must be brought back to our digital culture, today more than ever. Archetypes are archaic and collective representations (models) found first in mental contents proceeding from sensory experience and then manifested in culture (for example, archetypes figures in myths and legends).

Decades ago, Jung stated that *when individuating* the organism becomes *less predictable* in the face of general expectation. An organism in the process of differentiation undergoes an intense individuation process of heterogeneous and incommensurable properties. Whereas, the *more homogeneous* the organism is with respect to the dominant pattern, the *more unconscious* and therefore, the *more automated* it is:

> The more unconscious (*unbewußter*) a person is, the more this person will follow the general canon of psychic events. Conversely, the more aware of his individuality a person becomes, the more likely it is that its diversity (*Verschiedenheit*) with respect to other subjects will come to the fore, and the less it will correspond to the general expectation. It is also much more difficult to predict its reactions (Jung, 1995, p. 186, own translation).

From this point forward, this would indicate that *an automated or programmable society is a purely unconscious society* in which its behavior (desires, decisions, attention) or what Simondon called "affectibility" responds to the domain of the general dominant pattern. As we mentioned previously, one of Simondon's major cultural references[110], Mircea Eliade, formulated the tendency towards the collective under what he recognized as a "primitive ontology": there is truly no concrete, continuous, autonomous, linear history but a constant and cyclical return to a mythical time, the history of societies is nothing but the repetition of an archetypal regulation (Eliade, 1994, pp. 7-9). Eliade himself wrote: "reality is acquired exclusively by repetition or participation: everything that does not have an exemplary model is «meaningless», that is to say, lacks reality. Men will then have a tendency to become archetypal and paradigmatic" (Eliade, 1994, p. 48, own translation). For these authors, the archetype (a

[110] Thanks to Eliade's mythical and religious studies, Simondon was able to carry out his articulation of the systems of sacredness and technicity.

paraphrase of the Platonic *eidos*) corresponds to a structuring genesis of psychosocial reality. The archetype is, in this sense, a high-level technology. Half-mythical worlds open to each other: technicity and sacrality. In support of Jung's and Eliade's argument, Simondon noted the following:

> Jung had already established the overdetermined [*surdéterminé*] character of archetypes: an archetype is never the concept or the perceiver [*percepteur*] of a single thing; it is an image, because it condenses many situations into a single representation. Similarly, according to Mircea Eliade, there is a type of representations that resists rational analysis, and it is this type of representations that constitutes the content of culture (PST, 74, own translation).

Around five years later, Simondon returned to this thesis. One might thus observe that behind his philosophical program for the *unity of Culture* lies the germ of the archetype as a symbolic formalization proper to it. The greatest attention to the force of the archetype was underlined by Simondon in *Form, Information, and Potentials* (1960a), and in *Imagination et Invention* (1965-1966).

> The archetype can certainly degrade, but its ontological superiority should be noted: if one of the pieces is lost, only this piece become lost, whereas [...] the Archetype is superior to the piece; there is no complementarity rapport, for the archetype does not require pieces to exist: it is both anterior and superior; it exists before every piece (FIP, 679, 680).

> Naturally, it may seem strange to consider primary modes of thought as formalizations; however, in the images and symbols that form the common background of a culture (*le fond commun d'une culture*) we are indeed dealing with a formalization, especially according to the perspective of Mircea Eliade's studies. Mircea Eliade takes up in a rough way Jung's idea of archetype: the archetype is like a schema of the imagination, a mold of images belonging to the past of humanity (and perhaps to pre-human stages of the becoming of the species) (II, 129, own translation).

Those pre-human stages are precisely what we understand under the concept of patterns of ancestrality. From the very roots of culture the logic of patterns predominate. A few years later, Simondon in the *Cahiers de l'Institut de science économique appliquée* published an article under the name: "L'effet de halo en matière technique: vers une stratégie de la publicité", he explored the idea of the archetypal power (*pouvoir archétypal*) of the technical object as a model-producing force (EH, 283, own translation). For example, by referring to the mark of an automobile, Simondon said: "this mark represents in a certain way an indefinite source of archetypes; by buying a new model of the same mark, the user reaffirms his bonds of participation" (EH, 281, own translation). Before establishing a bond of participation with a model, publicity, criticized Simondon, conditions the psychosocial level of the individual (purchaser) by creating or displacing its motivations[111] with a solely commercial purpose. Simondon not only rejected the aesthetic surface of the technical object (the *surhistoricité*) for commercial purposes, but also its utility and its social symbolism (i.e., such as that of belonging to a social group only by possessing certain technical objects in question)[112]. If cognitive structures are related to *technological archetypes* (*archétype technologique*), Simondon concluded, it is possible to go beyond their commercialization in order to apply them to the design and invention of technical objects:

> In our opinion, *publicité* should therefore be considered not only as an art of making motivations play, but also, and *before* that, as a conditioning of cognitive structures based on a technological archetype (*archétype technologique*), that is to say, as an information task (EH, 291, own translation).

The archetypal force resides in its capacity to be imitated. This implies the preformation (*Vor-bildung*) and reproduction (*Nach-bildung*) of its copies (*Ab-bilder*) aspiring to the model (*Ur-bilder*). But then, when does the technical object become an archetypal potency? Simondon responded around 1960: when the technical object has the capacity of pregnancy (*Prägung*, imprinting) (PST, 43).

Another deep-ground cultural analysis, for the question of the tendency towards the general, is that of Gabriel Tarde who in his work, *The Laws of Imitation* from 1890, claimed that the source of *cohesiveness* in organization structures so much for living, physical, as well

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111 In *Initiation à la psychologie moderne*, Simondon dedicated a section to the motivation called "Le rôle de la motivation". Cf., Simondon, G. 1. (2015). *Sur la psychologie (1956-1967)*. Other words where he focused on this: Cf., *Attitudes and motivations* (1960), *La sensibilité* (1966-1967), particularly in: "Rapports entre la sensibilité, l'activité et la motivation".

112 Cf., His lecture in Lyon: *Psychosociologie de la technicité* in, Simondon, G. (2014).

as for social phenomena derives from the "universal laws of imitation". The latter concept mainly employed from sociological psychology aimed to address that there is a process of imitation (of various types) insofar as we relate to various social groups[113] (e.g., fashions and customs). Imitation means the action of using or copying a model and it meant to be designed as the very root of society and culture, he wrote:

> [O]ur clothes, our conversations, our information, our tastes, and our various wants according to one uniform pattern from which it is improper to depart. Its sameness from one end of the continent to the other passes for the most obvious sign of civilisation, just as the perpetuation for century upon century of certain legends, traditions, and customs was once taken, and much more wisely, for the foundation of a people's grandeur.
> [...] [I]mitation may be conscious or unconscious, deliberate or spontaneous, voluntary or involuntary.
> [...] I should add, to be sure, that many imitations are from the very beginning unconscious and involuntary. (Tarde, 1903, pp. 192, 193).

Arguing against Tarde's laws of imitation, Simondon put the following lines down:

> The equivalence of individual elements is not necessarily an identity of appearance (as Tarde thinks in his work on imitation) that leads to homogeneity of behavior (*l'homogénéité des conduites*) [...] We can call this possibility *social density* by which an element of individual existence gives rise to an equivalent element in another subject. This social density should not be confused with the homeostasis expressed by Norbert Wiener; in fact, social density is not necessarily self-regulating, as it only means that the holistic system exists through a high level of internal resonance; social density expresses the level of coherence of society. (CPH, 58, own translation).

[113] In their analysis of Gabriel Tarde, Djellal & Gallouj explain: "Thus imitation is the main element in social cohesiveness (there are two others: opposition and adaptation). Society is not defined by the economic criterion (or law) of utility (mutual exchange of services) and division of labour but by the criterion (or law) of imitation. It is made up of individuals who resemble each other because they imitate (or counter-imitate) each other" (2014, p. 2).

We see how Simondon as early as 1953 in *Cybernétique et philosophie* opposed the "dense" aspect to the "homeostatic" ones (the latter brings with it, in turn, feedback processes and, therefore, adaptation to the milieu). For Simondon, the so-called "social density" implies symbolisme (social behaviors open to modifications: "*symbolisme vocal, gestuel, postural*" (CPH, 58). The sameness entails relations between individuals. Simondon's relations, as we have already seen in Part I, imply structural transformations performed by information processes. Any information process can become a system[114]. Hence, for Simondon this gregarious tendency (the tendency towards general models) is read through energetic principles: the relations between individuals in the framework of a social group can become homeostatic if the values are fixed or they can also give rise to unexpected behaviors (e.g., revolutions), the latter being designated by him as "quantum" aspects of the social. In his analysis of Simondon, Bardin also derived the fact that:

> Societies of insects form a much more cohesive whole than societies of mammals, and this is why only the latter are open to further individuations. The less a behaviour can be reduced to the expression of predetermined patterns, the more individual development is independent of the group (2015, p. 90).

This is similar to the previous Jung's arguments, the more the organism differs from the general pattern, the more conscious of its own individuality it is. In Simondon's analysis on the gregarious behavior in animals and humans, he denied the idea of thinking of gregarious behavior only from the point of view of the biological species. The individuation of the vital towards the psycho-social or collective individuation goes beyond the category of species to become a psychic phase. It is not possible to reduce only the emergence of the collective to biological processes (that is to say, to adaptation).

In a rather less philosophically exhaustive analysis but sufficiently probable to fit the largest number of cases, the AI pioneer, Marvin Minsky, pointed out that this psychic tendency to base behaviors and then values on collective (socially accepted) models corresponds, partly,

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[114] Each system, in turn, is related to another:

> [...] its relations with the world are not mere influences, active or passive exchanges of energy; the object is considered here as a *holistic system* that has the relation to the world of an individual with a milieu, or of an individual with a society, or even of a society with a society (CPH, 42, own translation).

to the primary phases of psychic formation. That is, it is based on an infant's attachment relationship to its "caretaker" (Minsky called it "Imprimer"). In this sense, the adaptation of emotion stimuli with respect to external recognition does play a leading role for evolution itself[115]. In his work, *The emotion machine*, Minsky wrote:

> [...] each child makes "internal models" that help them to predict their Imprimers' reactions. Then each such model would serve its child as an "internalized" system of values- and this could be how people develop what we call ethics, conscience, or moral sense. Perhaps Sigmund Freud had such a process in mind when he suggested that children can "introject" some of their parents' attitudes (Minsky, 2006, p. 50).

Hovering over this conception, the recalled of Freud by Minsky, is not merely by virtue of "internalizing" early life's models of behavior but by another fact written by Freud himself in his work *Civilization and its discontents*: "By allowing *common feeling* to be our guide in deciding what features of human life are to be regarded as civilized, we have obtained a clear impression of the general picture of civilization" (1962, p. 43, own italics). We see once more the latent and profound unity brought by the affective-emotive background *(fond commun)* as shaping the cultural phenomenons at a very deep rooted level. This seems to us today more than a strong call to pay attention to the potentiality of algorithmic mediation to alter attention. This implies the activation of emotional states of varying complexity. Altering emotions enables the

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[115] High goals are those that allow social cohesion in later phases of development, since a large part of the individuals share these goals, namely, the goals of provoking actions that are not dishonorable or that do not produce shame (for oneself and in front of others). Minsky explain this by using a fictional character (Carol):

> In most other species of animals, the function of infant attachment seems clear: remaining close to parents helps to keep their offspring safe. However, in humans it seems to have other effects; when Carol's Imprimer prises her, she feels a special thrill of pride that elevates her present goal to a status that is more "respectable" [the opposite is the feeling of blame which is "dishonorable"] [...] her Imprimer's praise (or blame) appears to change the status of that goal into something more like an ethical value [...]
> It is easy to see why this would have evolved: if strangers called to change your high-level goals, they could get you to do whatever they want [...]. Children with no defense against this would be less likely to survive, so evolution would tend to select those who have ways to resist that effect (2006, pp. 44-45, own addition in bracketing).

activation/deactivation of attentional nodes and these, in turn, enable the modification of behavior or decision making as a whole (see, Figure 21). The general model is articulated at its very roots by affective-motor considerations.

By thinking about behavioral tendencies in view of models or collective patterns, behavior, may not only tend towards desindividuation, but also, in a simondonian sense, is a relational phenomenon capable of amplification and meta-stability (transindividuation). We shall examine this. Many studies currently attempt empirically to detect, measure, and reproduce at a computational scale the dynamic models of behavior (Gomez-Martin, et. al., 2014; Cipresso, 2015). However, at the basis of behavior-information there is not only an expression of neural activity that can be translated into a computational model (computational psychology and neuroscience) but, the affective-emotional (*affectivo-émotif*) modalities that give rise to more complex relations such as the psycho-social ones as well. Simondon specified how this information is not merely a consequence of structures and functions of neuronal activity in the following manner:

> These observations are not isolated; one can relate them to various categories of facts, be they animals or humans [...]. The support of information in organisms is perhaps not exclusively cerebral, which would explain the replacement of one nervous system by another (hereditary transmission only of the structures of the species) [...] the affective-emotive reactionary modalities, which play such an important role in choices (*choix*), define and fix the valence of images, which are one of the bases of the organization of behavior (*comportement*) (II, 94-96, own translation).

Simondon emphasized that the affective-emotive dimension for the organization of behavior unfolds in social reality (neither entirely psychic nor purely social, but psychosocial): “What Simondon means by psychic individuation is the formation of the psychology of individuals, as can be exemplified by their being in the situation of anxiety, grief, anger, and so on” (Hui & Halpin, 2013, p. 8). Precisely, “cultural features” (desires, fears, motivations, opinions, and others) partially equivalent to affectivity (intentions, desires) in Simondon (II, 131) are not attributes of reason nor structural functions of neural activity.

This helps to conclude that the welcoming to the aforementioned psychopolitics does not defy human intelligence, it is not an industry seeking spaces of conquest of “reason” but of attention and therefore, of behavioral patterns themselves. Thus, the “gregarious tendency” or “herdish reactions” as referred by Stiegler (2013) responds to the phenomena of similarity, predictability, and regularity. Thus, it becomes even clearer why the automated mechanisms are to be found primarily in culture.

CHAPTER VIII

Culture as the meta-pattern

§ 1. A culture based in the image-of (*Eikasthénoi*) its patterns

Between the pre-modern dialectic of the *poetic mythos-anima* (discernible in the sacred) and the modern scientific *logos-animus* (discernible in the reason), a *tertium quid,* a third position comes into play: a late-modern *pattern potentia* (discernible in information)[116]. We no longer search, on our own, under a cosmic-sacred worldview nor under the light of reason, but instead, we are given an approach to the world based on how our data resembles that of the others, favoring the affinity between individuals, strengthening behavioral patterns more than ever before. A culture based in the image-of (*Eikasthénoi*) its patterns is a culture attracted by the repetition of the similar or the uniform (*ὅμοιον*). Patterns of mathematical nature and cultural destiny may also reveal the cosmo-technological construction of our century.

As early as Plato in *Timaeus*, the discussion on the impossibility of uniform or similar patterns to become distinguishable from themselves (i.e., to change themselves) and non-uniform or unlike patterns to avoid destruction or separation between themselves (i.e., to unite one another) reaches its most essential point[117]. The body of the cosmos to be created by the techno-poetic artist, the *demiourgos*, involves mathematical proportions between elements in nature whose patterns are described as similar and uniform (*ὅμοιον καὶ ταὐτὸν αὐτῷ)* [57α]. This derives into a major problem: uniformity cannot produce change by itself, it resists change, and therefore, neither can it produce motion. The opposite occurs at the level of differentiated

[116] The core of technological operation, information, is the process in which not only patterns are created, multiplied (and perhaps diversified), it also opens as a historical-epistemological phase (hyperhistory) which takes elements from the previous phases but differs completely from them (Sect., Prolegomenon, Chapter II, § 3.).

[117] The details of the creation of the cosmos with respect to uniformity and non-uniformity of forms or patterns can be found thoroughly in: Cf., Glenn (2011).

patterns; they cannot interact and combine without destroying themselves or the other, they resist mixture. We can further observe that in their quest to perpetuate themselves the patterns are in a state of constant tension and struggle (*μὰχομαι*) with other patterns. By moving from ontology to culture, we experience the same problem. Many cultural classification systems and subsystems containing patterns of all types, such as those belonging to: identity, nationality, ethnicity, doctrines, traditions, values, norms, and others were historically founded through values anchored in *mitologema* (belief systems within the communities) but also later, in modernity, through the unifying force of reason, for example, we shall not forget how the identity of sovereign states was settled under the unified ideas of enlightened reason (Sect., Part III, Chapter VIII, §1.).

In both mythical-religious and rational-scientific phases there was an aspiration (not necessarily realization) towards truth[118] by its very nature. This drives to roughly assert that every pre-modern and modern culture attempted to systematized its uniformity and was dragged by value-traditions based on what is held to be true (again by following belief or rational systems). Now, in the third historical-epistemological phase such an aspiration no longer seems to take place. In an era of increasing simulation and models to imitate, this becomes a matter of concern (Sect., Part II, Chapter VI, § 2.).

The third and present phase, roughly identified as a hyperhistorical and hypercultural phase (Sect., Part III, Chapter VIII, § 2., 2.3.) is marked by the potentiality contained in patterns (*pattern potentia*) preceding from automated technologies (particularly that of machine learning). For some, some patterns predominate more than others, there is no rigorous classification, all online behavior is subject to the various relations submitted to many possible patterns.

Patterns of in-formation are not necessarily fixed and lacking of movement, they are distinguished by approximation, uncertainty, probabilistic eventuality between shared attributes. When functions and arithmetic proportions govern culture entirely (by conditioning its patterns), they do so, throughout patterns of shared variables or features. For example, two individuals belonging to different geographical places and cultures, with no relation to each other, can nonetheless, share the same behavioral segmentation cluster through which it is possible to understand, predict, and condition their behavior, for instance, by using their unique customer identifier for emailing or paid media retargeting.

[118] Although their means of accessing or attempting truth (always incomplete and therefore rich) were completely different, both had the task of seeking or approaching truth in order to bring it into correspondence with their effective reality.

This works even when the users consider themselves sovereign in their decisions. The force of patterns lies in the fact that they do not really operate consciously. This is precisely the purpose of the *selective attention tests*, such as the well-known invisible gorilla experiment conducted by Harvard University several years ago. The test consists of asking a control group to watch a video, in which they should count the number of ball passes carried by six people, three of them in white t-shirts and the other three in black t-shirts. The truth that the experiment reveals is that more than half of the control group watching the video fail to notice something obvious: the appearance of a gorilla in the middle of the scene. And what does this mean in light of our analysis? On the one hand, that our reality is composed exclusively of selected patterns (which are not conscious most of the time) and, on the other hand, that we miss much of the information presented to us even when it seems to be completely obvious. This experiment is a minimal reflection to understand how we are presented on a daily basis with patterns over which we are not conscious whatsoever. Technological pattern-based implementations constitute the ability to detect similar behavioral patterns through large datasets. Incidentally, culture, by means of applied mathematics, participates in patterns or models that bring together similarities and may also foretell the future. A culture joined not by virtue or values but by having likeliness.

This is the time of *con*-fusion, namely, fusion of sides, gregarious tendencies aiming to become alike or *herdish*. Shall the alike be united or divided? There is no demiurge that can dissolve this cultural and political thread. Against this tendency, there is a search for individuation from one to one, that is to say, the production of new and differentiated patterns out of the alike.

Managing uncertainty and improving the ability of models to capture patterns is the ultimate challenge of automated cognition: “This tension between radical uncertainty and inhuman cognition as well as our need to produce temporal command over data is one of the key features driving the growth of AI and its seemingly correlated discourses of mastery over futurity” (Halpern, 2021, p. 237). This is what Halpern calls “communicative objectivity” which implies “the turn to automation and big data as modes of managing extreme uncertainty” (Halpern, 2021, p. 232).

Taking into account uncertainty, for example, in the art of policymaking: decisions, such as the deliberation of services and improvement of operations, are becoming every time more the product of a complex process of hidden layers in black boxes. It is now left to the algorithms to find and generalize, without pre-defined hypotheses and unseen data, a profound synthesis of correlations[119] between statistical properties in the data itself. In hyperhistory, operations between-machines occur to an unprecedented level still requiring skilled human mediation in order to provide the inputs as well as general data-structures at higher level concepts. Machines do not merely learn to inductively identify a concept, an object, an image, an alphanumeric character, but the relation between learned patterns which responds to a higher level of abstraction (such as the behavioral segmentation). The association of online-behavior to new automated patterns of culture still has much to be explored. Still, a "pattern of culture" only emerges when it has a meaning in relation to us: "It is not enough to perceive details or ensembles organized in the unity of a good form: these details and ensembles must have meaning with respect to us" (ILFI, 268) wrote Simondon when considering the complexity of the concept of form.

In the mid-1980s, machine learning's most well known technique, connectionism (e.g., artificial neural networks), gained attention again through the "Parallel Distributed Processing" (PDP) from Rumelhart & McClelland (1986) also known by "backpropagation" and whose patterns explore the great variety of *meanings*. Margaret Boden explains: "[In] [d]istributed networks (PDP) each unit can be part of many different overall patterns, so contributes to many different meanings" (2016, p. 82, own bracketing with addition). That is to say, different patterns respond to different senses or meanings. As Mendon-Plasek explains, the 1950s concept of "pattern recognition" coming from AI researchers called for "contextual significance", which means, reliability in human judgment and robustness in machines to recognize patterns with unseen new data:

> This polysemous learning, instantiated mathematically in late 1950s pattern recognition as a loss function borrowed from statistical decision theory, fused day-to-day technical decisions for building pattern recognition systems with attitudes that linked creativity to mechanical schemes for generating contextual significance (Mendon-Plasek, 2021, p. 32)

[119] On technical relations Simondon indicated: "relations of technical correlation [*corrélation technique*], [...] are of an operative nature" (EC, 186, own translation). And such operative nature implies "the expression of a *technologie réflexive*" (EC, 186, own translation). According to the French author, this is not a terrain exclusively of science but explicitly of technology: "science determines objective structures by inventing operations, while technology produces operations by inventing structures. A machine is a structure capable of performing certain operations" (EC, 186, own translation).

Precisely, algorithmic models recognize patterns not by what we call "common sense" but through mathematical operations that associate (induce) the many training examples with new examples. Exploiting and working with patterns does not simply imply recognizing "objective functions" of some type: a face, an object, a musical piece, an alphanumeric character, or a sentence, rather, working with patterns also implies relations and mediations that are mainly cultural: selecting and generating a hierarchy or prioritization of certain attributes and parameters, together with psycho-social behaviors, and trends. It is of importance to clarify that not all predictive behavior tools necessarily involve machine learning or artificial intelligence, some proceed with or without the use of these latest techniques in the context of the Internet of Things, such as the so-called POL, patterns of life: "POL, to vastly simplify the definition, is a computerized data collection and analysis method used to establish a subject's past behavior, determine its current behavior, and predict its future behavior" (Brownlee, 2015). Still, machine learning (including deep learning) are the tools with the greatest development and implementation in diverse industry and market sectors. The exponential desire to expose patterns of life and culture in (computational) models can be exemplified, for instance, as follows:

> We have designed a taxonomy to categorize and describe complicated objects that would be needed in a virtual environment with sophisticated agents and potential human player interaction capability. Considering our desire to expose culture in our models, we embed culturally-affected «collective perceptions». Specifically, we use a culture's systems of regulation and core beliefs to influence how and when structures and environmental features are perceived. For example, behaviors related to food purchasing may be driven by norms like market days or religious observances (Silverman, et. al., 2018, p. 11).

Patterns are to become the most cultural-political concept of all. Just as Deleuze reminds us that each type of machine can be easily matched with a type of society (1992, p. 6), in a similar sense, every culture has its ways of producing, reproducing and transmitting patterns. However, with digital mediation, the patterns of culture enter a process of homogenization, polarization, containing decision and behavior, a deep desindividuation in which the same cultural digital media can also become of help to escape.

We should then see where to find the lines of research for this. For example, the direct or indirect relation established by other authors between «culture»[120] and «machine learning» has already deployed conceptual tools that serve as the driving force to be taken into consideration. Some of them understand this relation as «new organizational forces» and others as «operational forms of power» (both are not certainly exclusive). To the first group we recognize: "Hyperculture" Han (2005); "Algorithmic Culture" Galloway (2006), Striphas (2015), Hristova, Hong, Slack (2020), Hansen (2021); "Machine learners" Mackenzie (2017), "Cultural viruses" Dennett (2018), "Scripted Culture" Widmer, Kleesattel, et. al (2018), "Cultural analytics" Manovich (2020), "Algorithmic administration of culture" (administración algorítmica de la cultura) Berti (2020), "The Cultural life of machine learning" Roberge and Castelle (2021), "Phenomenotechnics of Algorithmic Culture" Hansen (2021), "Revolutionary mathematics" Joque (2022), and others. The second group includes: "Cognitive capitalism" Corsani et al. (2004), "Post-hegemonic power" Lash (2007), "Surveillance capitalism" Shoshana Zuboff (2018), "Computational capitalism" Stiegler (2016), "Algorithmic governmentality" Thomas Berns and Antoinette Rouvroy (2013), "Cybernetic totalism" Lanier (2010), "Siliconization of the world" Sadin (2016), "Nooscope" Pasquinelli and Joler (2021), and so forth[121].

The predilection for the term "algorithm" comes from the self-organizing nature of the systems to which cybernetics has referred since its beginnings (Sect., Part I, Chapter III, §1.). The emphasis is more focused on the algorithm and its operations rather than on the pattern upon which such operations take part. Just as in the cybernetic hypothesis an *agent* (animal, human, machine) is a subsystem within higher systems (Galloway, 2014, p. 114), in the same way, according to the relation between data, cultural features can already be regarded as patterns within higher levels of patterns. Culture, in the simondonian sense, is already algorithmic, it is

[120] When related to culture, automated algorithms are often shaded together with other techniques of the digital environment and sometimes even with classical statistical methods which are also operative and organizers of the networked environment.

[121] In contrast to the latter group, which is a distinction made by us, Hansen confirm its existence as follows:

> Against the tide of much recent scholarship and activist writing that, for all intents and purposes, collapses the digital to the operation of data extraction, Mackenzie suggests a more differentiated and more nuanced picture: [...] «the longevity and plurality of experiments, variants, alternative techniques, implementation and understandings associated with machine learning makes it difficult to immediately reduce them to capitalist captures of knowledge production» (Hansen, 2021, p. 25, and Mackenzie in Hansen, 2017, pp. 36-37).

the axis of unity and regulation. At the heart of culture, algorithmic mediation regulates the patterns produced in culture, regulating them means, virilizing certain patterns, conserving, and transforming others. Culture is the unity and regulation of patterns, it is the *Metapattern*.

Although categories have the flaw of inflexibility, in order to work with data in the field of machine learning, it is necessary to generate broad categories on which the algorithm can classify new data as clearly as possible. For example, one of the underlying obsessions of social media users is the des-individuating tendency to "follow", to "imitate", to "copy", to "repeat the opinion" of the behavioral model represented by their prominent figures of choice. In this scenario, the media brainwashing [*le matraquage médiatique*] as described by Stiegler employs its ability to shape cultural features into fixed patterns. An increasingly disputed case in the field is, for example, the prominent desire and obsession of becoming more beautiful (a deep-rooted cultural feature) which easily matches with some algorithmically guided *cultural* pattern (a stereotyped model of beauty) to be found in *models* containing certain patterns to be followed. This has become problematic (and the subject of legal charges) not only on an ethical level but also on a psychological level (especially for the young consumer) through the viralization and reproduction of patterns of beauty to be followed and filters designed to modify the face according to those fixed patterns.

Simondon considered beauty models as the reproduction of perceptive and symbolic patterns within their social context:

> It seems undeniable that, over time, there are variations in perception due to the change of collective patterns (*patrons collectifs*), of social norms that manifest a group effect; take, for example, the pictorial representation of feminine beauty through the ages in Western tradition: there are great normative differences; not only the posture, but also the shape of the body seems to have changed; in fact, it is undoubtedly rather a change in the way of perceiving; fashion, which is the reproduction of a perceptive pattern, facilitates the schematic perception of individuals; in other words, the perception of the socius is not only objective, but also at the same time symbolic (CS, 358, own translation).

The psycho-social cultural features (common motivations, desires, fears, opinions, and others) are algorithmically detected and related to each other while circumscribed within larger patterns of behavior. Here we can easily grasp that there is no "following" or "imitation" because of a rootedness to tradition or ensemble of values within culture (even when, for the given example, different cultures held diverse models of beauty, all of these followed the customs of tradition), instead, in the contemporary state there is an homogenizing *herdish behavior* (“following”, “copying”) of viral models, at an unprecedented level.

Only a few decades ago, the natural evolution of automated information systems sprinkled the seeds of a culture based on automated patterns. Cybernetics, according to Simondon, served as a methodological nexus (which he called *allagmatics* as we explained in Part I) to understand the process of information between diverse agents and at different systemic levels. The growing systemic orientation of the psycho-social universe towards the recognition, reproduction, and distribution of its patterns, and as an inference from this, towards the dynamic automation in which its operations take place, would explain the advent of the programmable society or what Stiegler called the “automatic society” (2016). The way of algorithms of extracting patterns, reducing complexity (noise) over unstructured data, according to Kate Crawford, leads to a new theory of the social:

> The belief that accurate prediction is fundamentally about reducing the complexity of the world gave rise to an implicit theory of the social: find the signal in the noise and make order from disorder.
> This epistemological flattering of complexity into clean signal for the purposes of prediction is now a central logic of machine learning. The historian of technology Alex Campolo and I called this *enchanted determinism*: AI systems are seeing as enchanted beyond the known world, yet deterministic in that they discover patterns that can be applied with predictive certainty to everyday life (2021, p. 213).

Today’s culture repeats, reproduces, and transmits at greater speed and with greater ease than ever the emotional patterns, precisely, by managing or governing attention on the base of an automated pattern-based culture. The future of human decision (willingness) is to be designed upon this, yet, the decisive point is this: today psychopolitics is practiced because it came to realization that affecting emotions (our attention span) is a much more efficient mechanism for rearranging psycho-social behavior than offering rational-critical arguments (such as a responsible critical debate). If this claim is welcomed, then one decisive and complex question arises: is culture an activity of unpredictable and creative invention or is it a tool of repetition of structures coming from social order, or perhaps it may involve the dialectical tension of both? In other words and bringing back the platonic tension described at the beginning of this section, shall culture be understood as a rupture or a repetition of patterns, or a combination of both? We explore this in the next section.

1.1. Culture: a creator or preserver of patterns?

The realm of order against the realm of chaos. This is an old ever-growing Babelic enterprise, from which, the many derivations of philosophical and media theory contribute to increase. In such a playground, this very question has already been addressed by Zygmunt Bauman in the early 2000s, in his work *Culture as Praxis*. Though, Bauman addressed it without precisely posing the idea of algorithmic mediation as a key producer and reproducer of patterns. There, he resumed culture between two radicalized alternatives: in the first discourse, culture is presented as a creative activity: "the notion of culture as the capacity to resist the norm and rise above the ordinary - poïesis, arts, God-like, creation *ab-nihilo*" (Bauman, 2000, p. xvi). For the second discourse, he explained:

> «[C]ulture» stood for regularity and pattern - with freedom cast under the rubric of «norm-breaking» and «deviation». Culture was an aggregate, or better still a coherent system of sanction-supported pressures, interiorized values and norms, and habits which assured repetitiveness (and thus also predictability) of conduct at the individual level and the monotony of reproduction, continuity over time, «preservation of tradition» (Bauman,2000, p. xvii).

For certain, we know that the above quotation is not part of the picture of our times, but rather, it belongs to what Bauman called "solid modernity", belonging to the modern period, as opposed to today's "liquid modernity", belonging to the current late-modern period. In the modern value-based and rational-based culture: what used to be precisely behind a pattern of culture?. There was group membership derived from diverse classification systems (e.g., nation, language, age, gender, ethnicity, occupation, political drives, spiritual belief systems, and others). Each classification system had its defining but also actualizing and repetitive attributes. For example, to the classification system "nation" belongs attributes, such as, cultural identity and traditions, nonetheless, "language" can also be framed within "nation" which exposes that classification systems can be unorthodoxically combined[122].

In the late-modern/contemporary conception, culture or hyperculture has no bodies, no ground, and therefore, no roots in tradition. In this case, there are no patterns (tradition-specific) to be repeated and transmitted intergenerationally. What we have are virally spread or censored patterns by a cultural agenda chosen by the media and subject to change (political change). And, through its digital milieu, instead of bodies in relation (face to face), culture is composed of floating gasses (this is an accurate description from Hermann Schmitz), no borders, no localizable anywhere (Schmitz, 1964). This is the "atmospheric culture" (Böhme, 1993), it includes everything without needing to include anything. At this stage culture is highly *heteropoetic*[123], it implies the continuous exchange with the outside, the generation of collective structures (models) based on cultural differences. Today it is the technological condition what fuses and expands cultural features; customs, beliefs, opinions and others while rendering useless the hierarchical and closed systems. Technology entails universality, trans-cultural exchange and, in the best cases, trans-individuation operating at the individual level, while in the worst, des-individuation at greater scale.

Yet, in an age of globalized and free-floating identities with no clear relation to any of the solid-modern patterns mentioned by Bauman, a critical question arises: to which patterns do then individuals might respond to?, especially: what drives individuals to imitate or follow certain patterns more than others if these are no longer tradition-based? Nowadays, when classification systems are culturally deconstructed or canceled what is extirpated are the very roots of previous cultural systems themselves. Late modernity's cancel or deconstructive culture is desruptive, it does not dismantle classifications or taxonomies but entire systems together with their corresponding set of values.

While desindividuation and its increasing uniformization occurs, a supposed multiculturalism[124] and anti-universalist particularism mask these events within the context of

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[122] These models were based on similarity and led by national culture and communitarians or cultural community (Bauman, 2000). These types of cultural-patterns generate conflicting models, which try to distinguish themselves from each other by limiting or suppressing attributes that may endanger their unity. This, in fact, can be made by "strict surveillance or censorship" (Bauman, 2000, p. xli). The relationship between these internal patterns or classification systems is what used to enclose a wide-system associated with culture.

[123] For the clarification of this concept, p. 30 in: Sect., Part I.,§1.,1.2.: *Technological individuation.*

[124] As Rattansi (2011) explains, the concept of *multiculturalism* began to take shape in the late 1960s and early 1970s through political agendas mainly coming from Western Europe, Australia, and Canada and was

a globalized and globalist society. Before being masked as a "patchwork of features", culture is formerly and most fundamentally the underpinning logic, the receptacle of all features. In Cassirer, this is clearly described: "culture can immerse itself in the study of its own forms, its own structures and formations (*Gestalten*)" (2000, p. 96).

If culture is the study of its patterns and patterns are algorithmically managed, does an automated pattern-base culture drive us to consider culture beyond its particularities and rather merged within vast datasets that lose such distinctions? In cultural studies, it is mostly not welcome any ahistorical spirit able to circumscribe culture *beyond the contingency* of historical, local events, beyond the subjectivity and customs of each individual in its particular contexts,

implemented in the popular vocabulary only in the 1990s. Although it is a poorly defined and ambiguous concept, a large part of the narrative is shaped by the cultural recognition (integration and right of retention of customs) of ethnic groups, cultural minorities, and immigrant populations outside the Anglo-European spectrum. Behind this recognition, multiculturalism is identified with notions such as pluralism, integrationism, cultural diversity, and ethnic minorities. The intersection of multiculturalism with other left-wing political claims or "new social movements" as described by Todd Gitlin is positioned in favor of all types of "minorities" including; feminism, animal rights, environmentalism, and others. This has currently led to channeling various different claims (with different objectives) as if they would belong to the same group. Hence, this has taken the name of "identity politics". Thus, the traditional conception of the left (previously based on overcoming class inequality) after the end of the Soviet Union took a very different shape through different movements (*molecular* in Guattari's sense). Rattansi expresses that, for some, identity politics has led to the distraction and to the oblivion of the *real* struggle to reduce class inequalities, while for others, class conflict was intertwined with social identities (Rattansi, 2011, p. 29). Although this debate is not the subject of study here, meanwhile, it is possible to observe that this agenda leads to increasingly polarized positions. This belongs to the analysis of what Stiegler (2011) calls *cultural capitalism,* in which not only the psychic and collective processes of individuation are liquidated but, in fact, the public power of the state and its classification system is liquidated. For Stiegler, cultural capitalism derives into a global industrial, political and *cultural decadence*.

as cultural anthropology has triumphed to establish since the end of systemic culture announced by Levi-Strauss[125] [126].

We have been accustomed to grasp culture according to its difference, to its contingencies, to its particularities, to a specific context, to the blunted subjectivity of the competent and particular observer according to his world-view, to its uncountable

[125] Cf., Lévi-Strauss, (1952). Andrew Tudor's (1999) analytical study of the history of cultural studies indicates that although there is no linear historical progression in the intellectual development of the field, there are a series of key moments for its emergence. For the author, one of these key moments in the birth of cultural studies as a discipline is the impact of structuralism. The author points out how, towards the end of the 1960s, several disciplines were influenced by analytical methods imported from Saussure's structural linguistics, and it was structuralism (particularly through Lévi-Strauss using and modifying the methods of Saussure's structural linguistics) what became the key to the birth of cultural studies as a discipline. For other authors, such as Charlie Gere ([c. 2002, 2008]), the emergence of modern structuralism began with the meeting between Lévi-Strauss attending the lectures of the literary theorist Roman Jakobson in 1942 and the same to Lévi-Strauss lectures on kinship (pp. 60-61). Likewise, structuralism implied the abstraction of phenomena in formal terms based on the nature of the sign, and such abstraction systematically influenced other disciplines, such as: "psychoanalysis, by Jacques Lacan, cultural and literary analysis, by Roland Barthes; political theory, by Louis Althusser and history, by Michel Foucault (though he always strenuously denied being a Structuralist)" (Gere, 2008, pp. 60, 61).

> It was structuralism that offered a flag under which an otherwise motley collection of inter-disciplinary mercenaries could unite, however precariously. And it was through the terms of structuralist theories that, at least for a time, diverse inputs could be synthesized into a larger endeavour. There is a real sense in which cultural studies is a child- a bastard child, perhaps - of structuralism (Tudor, 1999, p. 8).

However, it is important to make clear that "cultural studies" is a multidisciplinary and transdisciplinary field that also evokes areas such as: "linguistic, literary criticism, media research, sociology, philosophy, history, film studies" (Tudor, 1999). This gives it greater intellectual flexibility to take methods and ideas from diverse areas (Sparks, 1996) through the abstraction of social forms (Johnsons, 1986), which at the same time deprives it of "absolute origins" (Hall, 1980) and contains the dynamic and genetic potentials to compose and de-compose its methods, be they analytical or descriptive. In addition to the formative period (not necessarily representative) it is important to mention the influence of Richard Hoggart (1957) and Raymond Williams (1958), other key authors in the field include Turner (1990) and Storey (1993).

[126] We shall not forget that, as Heredia (2017) repairs that Simondon has shown null interest and even rejection in the face of the French structuralism, and in a different way, he linked himself with notions coming from the electromagnetic phenomenon, cybernetics, and information theory, which, as we see mainly through Levi-Strauss, are also matter of interest for structuralism.

permutations[127]. Such a base might be optimal when referring to the analysis of specific traits of cultures but may not be applied for the contemporary scenario where cultural features are merged in large datasets. The stream of becoming belongs to culture (Cassirer, 2000, p. 96), nonetheless, such a stream, today more than ever, follows patterns of "significant shared features", a form able to be recognized, re-oriented and re-arranged. Following Parsons definition "*[c]ultural objects* are elements of the cultural tradition or heritage (for example, laws, ideas, recipes) when these are taken as objects of orientation" (1991, p. 58). Nonetheless, classification systems or value-orientation features of specific cultures might be regarded today more as "technologies of discrimination and separation" (Bauman, 2000, p. lii) rather than the open possibility of cross-cultural dialogue provided by the differences and similarities themselves.

What does it imply that today's cultural patterns are produced in a different manner as the patterns of culture from the past? The patterns of culture, namely, value-orientation systems, may be internalized through the *formation* of the superego (Freudian hypothesis) (Parsons, 1991, p. 67) or, in fact, patterns of culture can be resisted through the *destruction* of the superego (hypothesis attacked by Stiegler, 2011, 2013, 2014). In the former case, the objects of the libido are internalized through authority figures, mainly models and patterns, on the basis of which sublimation and idealization are constituted, namely, models on which to stabilize the psycho-social structures. In the latter case, the destruction of the superego, the objects of the libido are lost and there is no longer a process of identification with the authority figures. Stiegler recognized this event as: a false identification with "liberation, emancipation, and autonomy". According to Stiegler himself, this can lead to the decline of the family (necessary for the superego) (Stiegler, 2014, pp. 16-17) and with it, the decline of the psycho-social structures themselves.

A *radical change* view aims to eliminate the patterns as a cultural-political tool, rather than investigating why they might be malformed. Culture is indeed a matrix of transformations but also, with great importance, of conservation of its patterns: the repository of human values. Nevertheless, this is only achieved through the actualization of its patterns coming from the social universe.

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[127] The "subject positioning theory" in cultural studies laid claim to poststructuralism of the 1970s, particularly in its psychoanalytical and historical materialist positions (*Screen theory*) as an informing perspective to the constitution of subjectivity (Tudor, 1999, pp 12-13). The referent sources that expanded these lines of thought are to be found in Gramsci, Lacan, and Althusser.

> Comparative studies of different societies have added to our historical evidence to show how various are the learned systems of behaviour and attitudes which groups of human beings adopt. Each of these systems, while it lasts, is the form of a society, a pattern of culture to which most of its individual members are successfully trained [...]
> A «pattern of culture», like a «social character», is a selective response to experience, a learned system of feeling and acting, in a particular society (Williams, 1961, p. 80).

Unlike William's patterns of culture driven by the learned experience within human groups, what we distinguish now is a new process, through the use of machine learning techniques, whereby the generation, transmission, exchange and adoption of patterns are being driven. It is no longer a "selective response to experience" but an "oriented response to algorithmic mediation". Culture must no longer be seen only as a process of patterns of culture coming from intergenerational values, experiences, and conventions, but more likely, as the relations coming from automation processes.

Cassirer considered symbolic forms (myth, language, art, and knowledge) as a spiritual conscious-processes shaping objective expressions, Parsons considered symbolic patterns (values, norms, symbols, e.g., ideas, laws, recipe, and others) as modes of organization of motivated actions within interacting systems. These are some of many types of pattern-formation in culture bound to the symbolic representation. Now when considering pattern formation in culture by means of contemporary automated technology, such as that of machine learning: data begins to be grouped indistinctly together into certain classifications and classes that will later be delivered as contents of an organized reality where some behave, dress, eat, purchase, talk, consume in a manner rather than other. For Cassirer, the role of culture was already to find the logic of relations behind symbolic forms, but what we now have is an automated process able to find such hidden relations, reproduce, and even modify them in black boxed environments. Culture, like the mind itself, is the product, logic, and history of the evolution of patterns. Machine learning in culture shall soon imply questions of the essence, functions, and type of relations from where the different computational patterns arise in order to meet new problems. Bauman becomes a necessary stepping-stone in this sense:

> Most cultural patterns reach the realm of daily life from outside the community, and most of them carry persuasive power much in excess of anything the locally-born patterns may dream of mustering and sustaining. [...]
> Motility, non-rootedness and global availability/accessibility of cultural patterns and products is now the «primary reality» of culture [...]
> It is the movement and capacity for change, not the ability to cling to once-established form and contents, that secures their continuity (1999, pp. xliv, xlv).

This observation perfectly fits within the context of the contemporary or late-modern condition whose cultural features are, to a great extent, non-rootedness. Lyotard illustrated it with great clarity: "In the postmodern condition one «listens to reggae, watches a Western, eats McDonald's food for lunch and local cuisine for dinner, wears Paris perfume in Tokyo and retro clothes in Hong Kong»" (Lyotard, 1984 in Greene, et. al., 2019, p. 5). In this sense, the cultural features conforming patterns can no longer be merely identified with dogma, the static order [128], and hegemonic or dominant position. Wiener already saw this more than half-a-decade ago: "We are but whirlpools in a river of ever-flowing water. We are not stuff that abides, but patterns that perpetuate themselves" (1989 [c. 1950], p. 96).

Indoctrination or identification with patterns produced in networks is clear evidence of the root causing the increasingly desindividuation we are experiencing (Sect., Chapter VIII, § 2, 2.2, 2.3, § 3., 3.1.). And at the same time, the lack of well-established relations between values and patterns paves the way for nihilism in culture. The pattern may be understood as a potentiality: the state of tension for modification or conservation of pre-existing cultural forms. The capacity for change or actualization in this view do not imply epochal relativism, but rather, the dynamics of models reflecting cultural-political expressions.

Today's practice of culture is an expression of the repetition, transformation, and creation of patterns propagated at a global scale that crosses the conventions specific to each culture. But this, again, shall not pave the way towards cynicism, relativism, and nihilism[129]. It

[128] Fromm mentioned the expression "cultural patterns" as an expression of what lacks dynamic elements in the social process, which he attributes to the theories of Freud (for removing the social dimension from the field of psychology) and also to Durkheim (for doing the reverse; removing psychological contents from the social) (1941, pp. 3-14). In his terms, dynamic psychology opposes cultural patterns.

[129] At the core of relativism and cultural nihilism, as already noticed by Stiegler, the trap lies in the belief that once the transmission of cultural objects or patterns by traditional or hereditary means is over, any kind of

is not the aim to overturn, not to oppose the existing histories explored by historians, anthropologists and ethnographers where the particularities of each culture are so specific that the observer can not but lose them in translation. It is known that each culture has its own *intelligence* in Anthony Giddens terms (1996), yet, underlying all cultural specificity there can also be patterns of culture discovered, recognized, or even generated by algorithms, a broader map that manages to put in relation the diverse cultural features.

This might be one of the keys to a return towards an analysis that puts in dialogue the difference of diverse cultures in question and give back to culture its objects of reference. Such an idea might be difficult to be seeded in late-modern times, not to mention how difficult could it be to accept that these patterns might be limited in number, and that therefore, they might repeat themselves, though, under different customs and shades: "eras, epochs, situations, persons are ever repeating themselves true to type [...] the humdrum facts of politics assume a symbolic and even a metaphysical character" (1926, pp. 4, 7) reminded us Spengler who became aware that all the elements that relate to each other in culture do so following some type, some pattern subject to modification.

As a matter of fact, human nature *resists* being exposed by the patterns of mathematical relations and computational recognition. Against this end, it uses the resources of language to poetically rescue its ambiguous "essence", it withdraws into ipseity (*Selbstheit*) in the sense coined by Heidegger, in the self-deployment of the spirit as a formative and transformative process of its own historical destiny which, in fact, might also be a repetition of models, of archetypes. In line with the work of Javier Blanco (2020), what for certain theorists (Tiqqun collective, Éric Sadin, and many others) could resemble an Orwellian or Huxleyan nightmare, that is, algorithmic externalization, might be read with new lenses. Simondon wrote: "Man no longer needs a universalizing liberation, but a mediation" (MEOT, 119). This very technological stage comes to uncover the essentialist criterion of "uncertainty" in human nature, described in terms of a nature impossible to compress to calculation, to measurement, to be located within a pattern. Although much contingency and uncertainty is lost and not retained within the automated computational patterns that are evolving in culture, that very fact does not make the essentialist any more distinguishable or creative. To provoke even more, creativity itself became also drawn in the AI production of computational patterns[130] receiving the name

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government of the patterns over culture no longer takes place and everything becomes an object of *becoming* (radical change perspective).

[130] In this regard, Arielli and Manovch (2022) have called this debate: "The Anthropocentric Myth of Creativity", where they argue how new AI systems that finish musical pieces like those of Schubert or Beethoven, or paint

of "extended aesthetics" (Arielli and Manovich, 2022; Manovich, 2018). In the face of the anti-calculating character to which human nature professes itself, Blanco argues that it is enormously inoperative to oppose from internal or illusory forums to algorithmic exteriority. In this way, he defines: "The «incalculable» as that which might escape data processing, repetition, and work as an engine of threatened human creativity. I believe that such a search would be fruitless but, most importantly, it is unnecessary" (Blanco, 2020, p. 194, own translation).

With the image of automated patterns, the tragedy of culture is truly experienced. The activity of culture is not only of a repetition of patterns, it is a recursive, Sisyphus-matter itself. *Culture is the meta-pattern from where all possible patterns derive.* Relating the pattern as a form of government of reality, Simondon turned to an archetypal thesis: "it is the smallest reality, the simplest, which serves as a paradigm for the largest, and governs it" (II, 182), or as he stated in one of his latest texts *Art et Nature. La maîtrise technique de la nature* (1980): "techniques [...] that tends to tame the infinitely large as well as the infinitely small" (AT, 191, own translation). Thinking about culture through archetypes or repetitive patterns might has been already present in Simondon's attempt to unify culture: "Culture is presented as a source of images and archetypes, while technics only define the civilization. [...] Culture in the major sense of the term implies, encompasses and brings together civilization and culture, in the minor sense of the term" (PST, 35, own translation).

Automated mathematics or machine learning find their finest expression in culture, where its patterns become highly functional (their statistical distribution applies and suits to many cases). It is not that algorithms have a special nature or power that allows them to turn culture into algorithmic culture, as observed in Hallinan and Striphas (2014), but that the patterns of a culture already reflect and express common mathematical relations that are identified by a function from which their unity, their convergence, their symmetries and asymmetries become recognizable. Culture is virtually mathematical before algorithmic.

> It is no longer a question, as our predecessors of the 19th century incessantly repeated, of translating the facts obtained from experience into the language of mathematics. It is rather a question of doing the opposite. We need to express in the common language of experience a deep reality, which is mathematically

pictures just as Rembrant did, are leaving behind the old idea that creativity belongs exclusively to the human domain.

meaningful before it is phenomenally significant. (Bachelard, 2004, p. 79 in Hansen, 2021, p. 58).

The problem of culture does not become a mathematical problem because of machine learning, it might already be a mathematical ἀπορία from its own root. This might be one way of revealing such a nature founded in ancestrality, reproduced in history and automated in hyperhistory (Sect., Prolegomenon, Chapter II). In two different valuable ontological frames (Sect., Appendix, §2.), on the one side, Deleuze thought of a metaphysics of calculus (1968), through which he later managed to see a passage from human subjectivity to numerical fragmentation (1990), and on the other side, Badiou recognized the ontological primacy of numbers (1988) through which govern cultural reality (2008). Now, could it be possible to make sense of the hyperhistorical patterns of culture coming from applied mathematical relations? Behind these models, there is what the great poet, Fernando Pessoa, called the "mathematics of Being"[131], whose actualizations, like those actualizations and potentialities of thought itself, can be regarded as *infinite* (Sect., Appendix, Chapter IX, §2.).

Culture, together with mathematics, share (by different means) a web of symbolic or approximate models derived from objects and experiences preceding from the human modes of existence. Behavioral patterns are what culture measures. Statistical derived patterns are what applied mathematics measures. At present, they work united and there is a mathematical-computational tool for this called machine learning.

§2. Implementing machine learning in cultural studies

As early as 1953, Simondon claimed that both the social (sociology) and the psychic (psychology) fields would find their true path (*le voie véritable*) through cybernetics [132] [133] (EC, 189). In his article "Epistemology of Cybernetics", Simondon remarked that both of these are

[131] This is explicitly noted in Badiou 2006, p. 30.

[132] Xavier Guchet stated a critique on Simondon's call to provide the humanities with models of physics and mathematics without arguing under what conditions conceptual extractions such as potential or energetics are carried out to the psychosocial field. Cf. Guchet 2010, p. 7.

[133] In spite of the common operational character between cybernetics and mathematics, for Simondon cybernetics differs from mathematics in the following way: "Just as mathematical theory is the operating system of individual science, cybernetics appears as the operating system of the collective subject" (EC, 190).

to become the two richest branches of cybernetics. Some years later, in a work written with Le Terrier in 1957 called "La Psychologie Moderne", both urged for the need of unification of psychology as a discipline facing problems and concepts similar to those of information technology and automatism in general (1957, pp. 1668, 1669). This similarity is generally based on *receptive* and *effector* attitudes in relation to the signals or inputs coming from the milieu: "The language of cybernetics, already applicable to the physiology of the nervous system, could make it possible to describe the relationship of man with his natural and social milieu, overcoming the alternative of freedom and determinism" (Simondon & Le Terrier, 1957, p. 1701, own translation).

It may not be immediately evident how technology can unify psychosocial analysis, still, this is precisely what motivates Simondon in his mature period (starting with the 1960's lecture "Forme, information, potentiels") to search for a general axiomatics of human sciences (Guchet, 2010, p. 5). He sharply observed that the importance of cybernetics, later renamed as artificial intelligence (Sect., Part I Chapter III, §1.), was not to be found in the results of the research but in its critical instrumental mediation, that is, its inter-scientific method. This gave cybernetics something much more significant than the instruments of measurement, it gave its genetic method, its axiomatic mediation, its own normativity, its "*outillage conceptuel*" (EC, 188-189). Cybernetics would become, according to him, a method for the *pure modes of operating*. To a large extent and despite much controversy, Simondon was already advocating at that time that *cybernetics* (*artificial intelligence) should become the method par excellence of the psycho-social behavioral field.* Simondon's solid philosophical attitude, not based on substances but on relations of information in the process of becoming, is precisely a theory of operations, precisely, what he meant by originating the concept of allagmatics in the very first place.

Applied machine learning along with culture act together as the field that studies longstanding well-established and new emerging patterns of psychosocial mediation at both the individual and collective levels. Culture is the very battle for patterns perpetuation and patterns anew, machine learning is the milieu to augment this very process. The field of cultural studies, enhanced by machine learning, might also become the greatest effort to articulate society and applied mathematics while emphasizing the significance in the relation of both worldsview. Just as Simondon indicated that cybernetics would allow sociology and psychology to embark on its true path as pure modes of operation, the contemporary inter-scientific methods of machine learning may allow culture to embark on its true path in a similar way. This is, more than anything, the enunciation of a problem: how small and large patterns can operate in the dynamics of a high-velocity, atmospheric, rootless culture. In other words, how to build a constructive critique relating the long-standing as well as the diverse emerging patterns that operate within culture, and what aspects of culture shall be taken into consideration for analyzing those patterns. It is also necessary to face the problem already presented by Spengler, that of how "different cultures exhibit different mathematical patterns" (Restivo, 1992, p. 9). All these choices are to become critical. The question of how to analyze patterns of culture can benefit from a machine learning perspective, although the range of probability where cultural elements spawn can hardly be fully grasped. On this latter idea Daniel Dennett explains:

> The only chink in the armor of AI is that word "vast"; human possibilities, thanks to language and the culture that it spawns, are truly Vast. No matter how many patterns we may find with AI in the flood of data that has so far found its way onto the Internet, there are Vastly more possibilities that have never been recorded there. Only a fraction (but not a Vanishing fraction) of the world's accumulated wisdom and design and repartee and silliness has made it onto the Internet. [...]
>
> AI in its current manifestations is parasitic on human intelligence. It quite indiscriminately gorges on whatever has been produced by human creators and extracts the patterns to be found there. (Dennett, 2019, pp. 70, 71).

This assertion openly leads to accept the limitations by which it is not possible to distribute probabilistically cultural features and their attributes nor to classify faithfully the correlation between data of individuals and clusters or "codes contained in a culture" (II, 164), namely, habits, traditions, belief systems, and others, in its various approaches (inherited or constructed). Without counting with the precision of today's methods, Simondon was already aware of this through his reading of Wiener:

> Social and psychosocial phenomena are generally explained by processes of interaction. But as Norbert Wiener notes, it is very difficult to introduce probabilistic theories into the social domain [...] Norbert Wiener is basically saying that random variations in the samplings of the human social domain do not permit veritable predictability or a veritable explanation, since the more the samplings are broadened, the more heterogeneous they are (FIP, 697).

Beyond its controversy, such an attempt is an unfinished, incomplete idea. There is no *made-to-measure* culture or as Georg Simmel called it, the "objectification of culture" but this should not prevent the field of cultural studies from enhancing through technology its objects of analysis. A great claim on this stresses:

> The representation of a person as a feature vector abstracts a "person" away from her socio-cultural network of meanings, identities, and values and represents her as a precisely-defined digital object in order to predict a very specific behavior, limited to a specific application. Human societies evolve over time and vary in their interpretations of codes of conduct regulating behavior (i.e., morality); yet, due to their abstract generality, mathematical objects and numbers do not [...] By incorporating more diverse forms of personal data into personalized scores, we may be able to reduce the gap between one's identity as a person embedded in social and cultural space and as a feature vector embedded in feature space. As we emphasize, however, the ML personalization process will never be perfect (Greene & Shmueli, 2019, pp. 3, 7).

How does culture operate through the processing of machine learning algorithms? There is neither a culture of all cultures nor, as Simondon noted with regard to the axiomatization of human sciences: "there is not an ultimate element; we are always at the level of correlations, whether we go toward the search for elements within the individual or toward the vastest social groups" (FIP, 678). In other words, culture, through the mediation of machine learning, operates at the level of correlations either of the data of the individual with respect to the group or of the group itself. Therefore, the principle of correlation, or as usually called: *matching*, is found as the crucial measure of analysis for both the field of cultural studies and the field of machine learning.

Yet, there is a terrible fatigue of the human being not to feel constrained, enclosed, confined, asphyxiated, assaulted within numerical relations. We continually assert, to the *ἀταραξία* of many and to the methodological honesty of others, that numerical features or simply numerical symbols in their most abstract sense, do not have the capacity to contain contingent and progressively developing cultural experiences, and that the only thing that algorithmic prediction measures are observable behaviors in the online environment. As Simondon pointed out in *Recherche sur la philosophie de la nature* (1955), it is Spinoza who already reconciles the cognitive structures of the human mind (adequacy of thought) with the mechanical-geometric forms of the world. In a less rigorous and formal but rather approximate and probabilistic sense, the psychosocial structures of the human mind (adequacy of behavior) are brought into relation with the numerical patterns preceding from the digital milieu.

We are facing a historical-epistemological passage to hyper-history, where the relations between-machines predominate (that is to say, interobjective relations: Latour, 1996; Stiegler, 2012; Morton, 2013; Hui, 2016) and where, as we have already remarked (Prolegomenon, Chapter II, § 2., 2.1.), these relations augment the production of patterns as never seen before. Hyper-history can only occur in an automated pattern-based society. It is no longer possible to think of a feature of numerical relations as alien to the human cultural architecture itself, nor is it possible to offer an idea of behavior and decision making processes without considering the nature (albeit incomplete) of algorithmic evolution.

When reflecting on the specific conditions of technical evolution, Simondon held that in the limits lies the key to progress[134] (MEOT, 32) and that progress as such responds to a very incomplete nature: "This unfinished, incomplete idea of progress, contains a message for posterity; it cannot fulfill itself within itself. One of the aspects of *Les Destinées* [Destinies] is to accept living within this moment of technical evolution" (MEOT, 133).

Beyond the large limits found today in the vast disproportion of data, there are certainly important and also valuable objections to the idea of turning machine learning into an instrumental mediation for cultural studies. Both of the well-known machine learning scholars from digital humanities, Alexander Galloway (The cybernetic hypothesis, 2014) and Adrian Mackenzie (Machine learners, 2017), agree on the following:

> Galloway also observes that even if "cultural workers" do manage to learn to machine learn and become adept at repurposing the techniques in the interests of *analyzing culture rather than selling things or generating credit scores*, they might actually reinforce power asymmetries and exacerbate the ethical and political challenges posed by machine learning (Mackenizie, 2017, p. 12, own italics).

We shall not be horrified so easily. Culture itself is a manipulation technique. Simondon wrote in *Culture et technique*: "«culture» and «technology» are both manipulative activities

[134] Simondon addressed the concept of progress in *Le progrès, rythmes et modalités.* This is an unpublished text corresponding to his course at the University of Poitiers in the late 1950s. Cf., Simondon, G. (2015).

and therefore are techniques: they are even techniques of human manipulation (*maniement humain*)" (CT, 318, own translation). Culture, with the aid of technology, is precisely the greatest force of transformation of the milieu, that is to say, culture is the cultivation of the human species (CT, 318). As we wrote before, instead of reinforcing the idea that cultural differences divide waters, this shall be an open opportunity for a genuine cultural exchange and open dialogue (Sect., § 1., 1.1).

Regarding Mackenzie's and Galloway's warning, there is an enormous literary production in this regard confirming such claims, in which machine learning could be placed as a danger by the production and reproduction of asymmetries (inequalities) found in culture, starting with: biased decisions of those who have the power to declare the parameters, erroneous sampling, and development of the algorithms, lack of quality, objectivity, and quantity of data to draw conclusions, the inflexibility or inaccuracy of the categories on which the data are circumscribed, the lack of explainability of the model (black box problem, i.e., if the automated decisions can be explained), the lack of transparency in the collection of data and the fairness of the decisions made by the system (robustness), the irresponsible data management and privacy, the safety problems such as, external threats to the AI system and the validation and verification of software systems. And beyond the technical risks, for the human-agency side risks are also fundamentally high: the algorithm's recommendations containing disinformation from online platforms, ease of predicting behavior while enabling the manipulation of individuals (e.g., political or purchasing decisions), ceding control to machines driven by the companies with the biggest cloud services, the establishment of centralized social organization, increasing reinforcement of addictive tendencies, the enhancement of a gigantic Skinner's box-style stimulus-response generation system, the dangerous disappearance of the difference between reality and simulacra, and of which implies a deep process of desindividuation within.

This can be fully triggered (and in countless examples has already been triggered) by driving unreliable technical-uses and policy-decisions in the socio-cultural field. The biggest picture of the *inhuman use* of human beings [135]. In line with Wiener's arduous expression: "the

[135] Wiener explained this in the following manner:

> Its real danger, however, is the quite different one that such machines, though helpless by themselves, may be used by a human being or a block of human beings to increase their control over the rest of the human race or that political leaders may attempt to control their populations by means not of machines themselves but through political techniques as narrow and indifferent to human possibility as if they had, in fact, been conceived mechanically. (1989, p. 181).

human use of human beings", Simondon understood that culture is the place for "the cultivation (*élevage*) of man by man -that is how culture should be called-" (CT, 318, own translation). Thereby, Simondon did not make technology the means of cultivation of humanity, but rather, technology and culture respond together to such activity.

This is not a lament. Machine learning methods, under critical and constructive development, may or may not lead, like cybernetics foreshadowed, to perfecting the path towards a "doctrine of values" (*doctrine des valeurs*) (EC, 192). Such applications have already become a "center of unity and action" not only in the various branches of science and its applications, but also in the artistic, ethical, and political expressions of society itself. Artificial intelligence in its wide diversity as a system of operations has become a universal axiology from which all other branches are nourished. In addition to integrally traversing social relations and interactions (Yolgörmez, 2021), besides, machine learning acquires its patterns, puts them in relation and modifies them and that is precisely where culture fuses within.

A question remains: what is exactly the social purpose of analyzing the patterns of culture? It is known that it shall not be applied to exacerbate asymmetries, prejudices, or ideology nor shall it serve for mere reminiscence, instead, patterns "conceal a sense and therefore an end to collective action" (EC, 195, own translation) as Simondon reflected on the relation between mathematics and effective reality. We are confirming the fact that while Simondon still hoped to incorporate technical objects into the traditional world of meaning through his program of cultural reform[136], the evolution of technical objects, which are now fundamentally mathematical objects and relations, had long since transformed the sense culture itself and even the sense of sense (Hörl, 2015, p. 4).

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[136] Simondon's cultural reform through technology is presented in an early article of 1954 as follows:

> It is therefore necessary to create a new culture, a new schematism appropriate to the human world and the natural world. The most stable and universal mixture of the natural world with the human world is the set of technical beings (PRE, 241, own translation).

2.1. How a model becomes cultural

In the artificial intelligence epoche[137], it is no longer a question of the displacement of man by the machine for bearing tools (physical work) nor its displacement in cognitive tasks (mental work) but a more radical displacement: that of *pattern awareness*. As we already elaborated in the first part, pattern detection is not only the foundation of the entirely psychic configuration of the subject since its early sensory stages but it also plays the most important role in its daily decisions by reason of its repetition and therefore automatization.

Patterns shape our reality just as they shape the reality of machines. Algorithmic models are components, but also outputs, of cultural phenomena. Their information is a slight abstraction coming from social relations and human experiences which also changes throughout with them. This is the main reason why many scholars consider machine learning not as the learning of the algorithm "on its own" but as a human-machine approach (Mackenzie, 2017; Reigeluth & Castelle, 2021). Simondon himself was very critical of the idea of the "perfect automaton" as it has been extended earlier (Sect., Chapter V, §2. , 2.2.) which bears resemblance with today's idea of the machine that "learns by itself". Precisely, it is human mediation that enhances machine learning's development, and if anything, its evolution.

Machine learning evolution is guided by solving problems in light of the novelty (unseen data). Simondon considered adult learning as the capacity to: "responding to the novelty of the circumstances of the environment through the intelligent invention of solutions; it can largely manage unpredictability, not through the rigidity of stereotyped behavior, but through the universal richness of its learning" (PRE, 240, own translation). Machine learning, as a potentially *evolving* technological and cultural phenomena, shares and reproduces two common features already worked in Simondon's literature: first, machine learning models learn by a genetic, procesual operation, and second, that operation of exchange with the milieu (implying the learning procedures) demands a transductive process, i.e., a chain reaction that spreads little by little (API, 162) while penetrating and modifying the deepest layers of the cultural features. Regarding the first aspect, Tyler Reigeluth and Michael Castelle when analyzing machine learning recognized: "concept learning is a genetic (i.e., developmental and

[137] Simondon conceived that technical culture should allow the act of liberation of the machine. Liberation from what? from the servile machine, from the machine as a means or instrument. That is, liberating the machine from what Heidegger called, the anthropological thesis in *The Question Concerning Technology* from 1954. This is actually occurring. The machine in hyperhistory is the user, the means, and also the very end of information processes (Sect., Prolegomenon, Chapter II, § 3.).

processual) social activity in which individuals take part in meaning-making and, in doing so, transform both themselves and society" (2021, p. 82). A progress of adaptation and learning that develops in groups is precisely what Simondon recognized in his course *Le progrès, rythmes et modalités* within the *sociogenetic domain*[138]. Sociogenesis, like ontogenesis, implies adaptation, disadaptation, and finally, a new reorganization of functions and structures (energetic theory of form-taking), although he regarded it, in a non-probabilistic manner (FIP, 697). In reference to the development of behavior, Simondon summarized its potentials in these terms:

> The «patterns», i.e. the schemas of an initial adaptation, seem lost the moment when one arrives at dedifferentiation, but, in fact, they found to be reincorporated into the new adaptation [...] If we step back from the individual being, we can wonder whether *social reality* also contains potentials. (FIP, 693, 697).

"Social reality also contains potentials" states written above. But how does it relate with the potentiality when referring to automated algorithms and data? This forces us to return to the transductive sense of information[139]. Simondon wrote some years later in his conference paper *L'amplification dans les processus d'information*:

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[138] Sociogenesis is related to what Simondon, through Arnold Gesell, calls the "ontogenesis of behavior":

> [T]he ontogenesis of behavior, from conception till death, is an evolution that marks the succession of a certain number of stages, sometimes of adaptation to external worlds, sometimes of the at least apparent dedifferentiation of adaptive adjustments and the search for new adjustments (FIP, 692).

In the ontogenesis of behavior, such patterns contain strongly associated concepts: learning and progress. Progress, according to Simondon, requires not only a crisis or a degradation but also a process of regression, a return to previous stages of learning in order to reorganize and incorporate new functions. In the examples cited by the author, we find the ontogenetic process of development of a child, who starts by adapting to the world and to himself through crises of maladaptation (to move to crawling on the ground requires a crisis, which is then repeated when moving from crawling to crawling, and which is repeated again when trying to learn bipedal walking). These crises contain phases of oversaturation of the locomotor system in which the child assembles and disassembles the functions he had learned until he reaches his goal (FIP, 693).

[139] The concept of transduction has already been worked in the Chapter III from Part I.

> The technological models that employ a transductive process assume the possibility of a chain reaction that propagates little by little; [...]. The phenomenon remains informational (*informationnel*) if the link from element to element is made by means of a transmission, but with the condition that this transmission is only the expression of the change of state of the previous element (API, 162, 163, own translation).

Therefore, for information to be transductive there must be primarily a transformation or change from one state or form to another. These transformations cannot be reduced to changes in logic gates and signals in electronic circuits. Information transcends the morphological states of electrical energy to become a metaphysical process. When we refer to metaphysics in the simondonian sense we are referring to transductive operation, i.e.: form, information and potentials (FIP, 675). In his secondary thesis from 1958, Simondon underlined the importance of different transductive roles corresponding to each machine in each epoch while being associated with human as an associated milieu:

> The technical object is not directly a historical object: it is subject to the course of time only as a vehicle of technicity, according to a transductive role that it plays with respect to a prior age. [...]
>
> Man's relation with machines takes place at the level of the functions of transduction (MEOT, 76, 156).

This is the technical object's essence all along. Hyperhistory comes into being by technicity and transduction. This means that in an age of machine-to-machine relations technology is relieved of its intermediary role and plays, in turn, a transductive role. In this sense, the potentiality of the social realm and the algorithmic potentiality become intertwined. The automation of mathematics (ML) has the potentiality to overpass technical objects in order to transform them. Even more, these applied mathematical relations reframe culture whether within stereotyped attitudes (desindividuation) or by inventive life (transindividuation). Technology (a regulation between operation and structure) lies between the human world (a world of sense) and the natural world providing both with normativity, with unity, with form:

> Unfortunately, this world is still devoid of unity. We need to move from techniques to technology. The technical being is the concrete symbol that allows

> the richest and most universal interhuman relation, because it passes through a product of intelligent learning (PRE, 241, 242, own translation).

In hyperhistory, algorithms reach a genetic status, that is to say, they provide not models (forms) in the platonic sense but genetic models of reality, models of intelligibility able to transform themselves. When transduction occurs by means of technology and, we add, at the level of the metapattern (culture) itself, the need of models (genetic archetypes) arises:

> Instead of conceiving an archetypal form that dominates the totality and radiates above it, like the Platonic archetype, could we not posit the possibility of a transductive propagation of form-taking that incrementally advances within the field? In this sense, it would suffice to suppose that, after having modulated a zone immediately in contact with it, the archetypical germ utilizes this immediately proximate zone as a new archetypical germ to go further (FIP, 696, 697).

Ten decades later of the calling to a new archetypical germ as expression of transductive propagation, he wrote in his 1970s lecture: "Naissance de la technologie" (*Birth of technology*) when considering the relation between transduction and technology:

> The theory of information, the theory of communications and above all cybernetics provide models of intelligibility (NT, 171, own translation).

After some other decades, we can assert that artificial intelligence, in the very general sense, provides us with genetic archetypes, technological archetypes, namely, models of reality able to propagate and generate patterns of all types, turning culture into automated pattern-based culture.

CONCLUSION

This research has proposed to devise a conceptual framework based on the three axioms: ontological, technological, and cultural-political. All of them joined by means of the concept of «*pattern*», the kernel shared between culture and the mathematical automation of machine learning. The growing role and importance of the recognition, the production, reproduction, conservation, and the transformation of patterns in both, automated systems and culture, is not an epistemological or historical isolated event, it dates back, as we have explored, to connect a worldview and its evolution (ancestrality, history, hyperhistory) (Sect., Prolegomenon, Chapter II). At the heart of the most important issue shared by human and automated cognitive systems is the construction of a reality based on the perception of patterns and, by means of them, the ability to employ models able to operate effectively in the milieu.

It's all about patterns. Patterns create the perceptive and psychic human and machine views of reality and organize our behaviors. In an era in which artificial intelligence is entirely reshaping our modes of existence, it has been necessary to emphasize all along not only the different types of patterns in their contexts but even more under what conditions patterns have become the very point of emergence, production, and organization of human and machine realities. This framework has led us throughout the first part to develop *the ontological axiom*: patterns in-form (give form) to reality (Sect., Part I). Here the key concept has been that of in-forming (shaping) which evokes the thesis of Simondon with respect to the concept of information, the variation of one form into another. After introducing Simondon's major concept of individuation and information (Chapter III, §1), in order to capture the extent of evolving pattern-cognition in Simondon's theory, we have faced his limitations regarding the field of mathematics which is also extended all along (Chapter III, §1, 1.3 and Chapter IV, §1) while considering his appreciation of the field as an operation rather than a structure (EC). We also went in depth with a completely unexplored aspect along Simondon's work, precisely, the concept of «*patterns*» (Chapter IV) in both senses, as mental images (where Simondon got closer to Jung's archetypal forms) and in terms of perceptive experience (where he classified it according to different sensorial and instinctive triggering stimuli). The latter particularly to be found in *Individuation…* from 1958, *Cours sur l'instinct* (1964), and *Perception and Modulation* (1968) and, the former, in *Imagination et Invention* (1965-1966). It has also been decisive to understand Simondon's resources (summarized in figure 8) in order to clarify his notion of form as that which left behind substantialist metaphysics to bring a relational metaphysics also related to technical objects at large.

One of the decisive facts of modernity has been that of the extension of the machine and a greater restriction of the human in technical activity (Rodriguez, 2007, p. 15). This extension exceeds the (prosthetic) functions, to turn itself fully in an extension of *forms*: "We can create technical beings because we have within us a play of relations and a matter-form relation that is highly analogous to the one we constitute in the technical object" (MEOT, 62). In other words, what we develop at the technological level is nothing more than an extension of the relationship between patterns at our disposal. Everything we come recursively in contact with turns into a conditioning pattern of our existence. The patterns reproduced by technology, reflect our own patterns themselves, they become *dominus*. Even more, the decisive point is no longer the extension of the machine as the tool-bearer[140] but as information-bearer, and therefore, as a pattern-bearer. We referred mostly along this work to the machine that recognizes patterns, not the one that bears tools, not the machine that takes the place of the human, but the one that accounts for its cultural features at all levels.

During the present century, the decisive *aretḗ* seems to codify nothing more than the *symbolic-cultural dispute for the recognition, regulation, reorganization, reinterpretation, and reproduction of cultural traits that will become models.* Just as in Simondon the technical progress of technical objects existed increasingly less as an *object* and more as a *symbol* (PST, 85), so too the traits (attributes) conforming a pattern are every time less considered as mathematical relations regulated by automatisms and every time more a cultural force. The genesis and becoming of machine learning, heir to many previous techniques and interrelated fields, mathematical branches, and interdisciplinary methods in conjunction with the technical reality, rests on this very criteria.

Along the second part we developed *the technological axiom: patterns can be computationally automated* (Sect., Part II) where we extended on the importance of the concept of model and pattern from the point of view of machine learning systems. This drove to extend,

[140] Simondon wrote in this regard:

> [I]t is now the machine; tools are borne by the machine, and one could even define the machine as that which bears and directs tools. Man directs and adjusts or regulates the machine, the tool bearer; he realizes grouping of machines, but does not himself bear the tools (MEOT, 78).

without losing the philosophical insight, on machine learning's enterprise of compressing dimensions (hyperspace) (Chapter V, §1.), how ML represents space (§2., 2.1), to classify two representational views on the concept of model (formal and statistical) while grasping the problem of methodological unity in ML (Chapter V, §1., 1.1), to clarify learning by managing data's attributes (Chapter V, §2.) and related aspects. Also the problematization of the black box concept (Chapter V, §2., 2.2) became helpful to intervene in the contemporary debate of the "unknown" from the human perspective and whose uncertainty, following Simondon's line of thought, is the key to learning and evolution. This led again to grasp Simondon's reflections of the technical object (Chapter VI) and its evolution by means of the essence of technical beings, namely, the genesis and the uncertainty, while considering other classifications such as their use, historicity, and technicity (Chapter VI, § 1.). This helped us to conceive a three-phase evolution of the technical object (craft-agricultural, industrial-manufacturing- post-industrial/hyper-industrial productions) and to warn how automation implies a new return to abstraction that contributes to our study on patterns. Precisely, this higher turn into abstraction implies the reproduction and simulation of reality itself. This became finally explicit by introducing the problem of indistinction between reality and simulacrum (Chapter VI, § 2.) for which Simondon's understanding of the tension between culture and techniques has been presented. While Simondon observed, by the end of the last century, how culture fortified its defensive wall against technology (MEOT, 15-16), and aimed to create a technical cultural program, today *we certainly witness the opposite*, namely, how culture builds cognitive technologies and how these, in exchange, manage to shape culture itself by accessing large datasets.

For Simondon, culture was the one that should occupy that regulatory place of information processes, while at the same time, it should function as a space of awareness for the machines themselves, their essence, as well as their nature:

> Culture, which has become specialized and impoverished, must once again become general. By removing one of its principal sources of alienation and by re-establishing regulative information, this extension of culture possesses political and social value: it can give man the means for thinking his existence and situation according to the reality that surrounds him (MEOT, 20)

Simondon claimed that "culture must incorporate technical beings in the form of knowledge and in the form of sense values" (MEOT, 15) this is precisely what we have aimed to question throughout the third part, the *political-cultural axiom: culture is in-formed by computationally automated patterns* (Part III). For this part we aimed to expose how the concept of pattern revealed more cultural and philosophical problems than ever before and explored how it is connected to the field of culture itself. In this vein, we undertook the task of situating the concept of culture from its pre-modern, modern, and contemporary views (Chapter VII, § 1.), still, focusing particularly on the latter. Such an extent unfolded the process towards desindividuation which had been broken down into Simondon (Chapter VII, § 2., 2.1.), Stiegler (2.2.), and our understanding of it (§ 3.). It is the concept of desindividuation what became our major analytical tool for presenting not only the mastery of psychopolitics (the emergence and management of psychosocial and cultural traits) (§2., 2.3., §3., 3.1.), but also, the growing tendency of society of becoming culturally re-arranged under the force of automated patterns of culture.

When each online event is absorbed into a pattern, culture becomes the field of management for all those patterns, the meta-pattern (Chapter VIII). Such a mathematization of culture does not entail the "measuring of all forms of existence by their qualities" (Povinelli, 2016, p. 5), but rather, the power of formation of patterns to in-form reality (the ontological axiom). The patterns of culture are now not merely a product of human sense-giving but a process of automatization guided by cognitive technologies, technologies of the spirit, or as we called it here *technologies of the unconscious* (Chapter VII, § 1., 1.1, § 3.). Simondon's reflection on culture as the greatest mediation of all, as the very tool to govern all other dimensions (political, economical, psychological, social, artistical, and others) allow us to conclude and repeat the claim that it is the very field of culture where AI undertakes its most important battle.

In this sense, "culture intervenes as limit rather than as creator" (MEOT, 193). While we move towards an automated pattern-based culture, whatever may be particular becomes rapidly absorbed into some pattern. Culture is the metapattern where all other small patterns and its dynamic features are to be rearranged, organized, and established as models: to follow, to imitate, to copy. This is also expressed in the following quotations:

> Culture must remain above all technics, but it must incorporate into its content the knowledge and intuition of genuine technical schemas. Culture is that through which man regulates his relation with the world and with himself; and yet if culture were not to incorporate technology, it would contain an opaque

zone and wouldn't be able to contribute its regulative normativity to the coupling of man and the world (MEOT, 234).

> We are seeking to define and consider one central principle: that of the essential relation, the true interaction, between patterns learned and created in the mind and patterns communicated and made active in relationships, conventions, and institutions. Culture is our name for this process and its results (Williams, 1961, p. 72).

Lastly, this research may hopefully nurture further theoretical but also practical developments and implementations. Defining culture as a metapattern containing all possible patterns (in a genetic sense) gives place to explore databases under this view, that means, to consider and analyze predominant attributes (cultural features) in relation to how its patterns are first, recognized, and then selectively reproduced and automated by ML algorithms. Machine learning can become the key to explore the very essence of culture, that is, its underlying patterns. As a side effect of applying machine learning in the field of culture (Chapter VIII, §2.) rather than as neuromarketing might help to contribute in the near future, always in a limited manner, to a better understanding of the picture of our times, of the challenges to overcome in order to relate and communicate different patterns proceeding from different cultures. This implies, to generate not only a technical but a philosophical effort in this line.

The evolution of artificial intelligence is an evolution in the understanding of patterns of the world, and now, of culture itself. Considering culture as the playground of archetypes or repetitive patterns was already present in Simondon's attempt to unify culture (Chapter VIII, §2., 2.1.). Cultural databases and cognitive technologies are psychopolitics, they shall serve as a basis, not of *enframing* or nihilistic closure in the Heideggerian sense, not of quantifying the spirit, not of des-individuation, but to raise technology together with culture to the highest level of transduction where technicity and sacrality meet and where Culture becomes unified.

The technical-system captures the abstraction of the previous phases of human progress, but technics have also been saturated. We are manifestly confronted with a new process of becoming of human activity, which must integrate the previous phases of civilization and overcome them at the level of abstraction[141]: "Nothing allows us to think that, after having brought technical development to saturation, if this saturation can be reached, the human species will not have to enroll in a new domain of progress" (LPH, 270, own translation).

The apotheosis of evolution is culture itself. Culture is the land to conquer, culture is where the future of automation is to be played out since it is in the domain of culture that the models and patterns that will regulate psycho-collective behaviors and individuations are designed: "the individual, by using his own resources, can help to change the pattern, in order to meet new problems" (Williams, 1961, p 82). Progress has reached its saturation with technology. Progress is no longer technological, it begins to be *techno-cultural*[142] or, perhaps even better, *psycho-technical* in the very first place.

AI is a civilizational project. All this indicates, as Sadin (2018 [c. 2016]) warns, that we are no longer simply facing a new industrial model, we are facing a new civilizational project. That is to say, we are facing a growing abstract cultural level developed, assisted and accompanied algorithmically. If culture has been historically preceded by the formation of patterns through meaning (*Sinn*) granted by human agents through founding myths (pre-modern period) and through reason (modern period), the current period is marked by the formation of patterns of culture by algorithmic mediations. Attention (derived from configurational patterns as desire and fear) thus becomes a statistical approximation that will be formed according to so many other individuals who share attributes similar to one's own. These patterns are not simply forms generated or extracted through algorithmic mediation of data, these patterns express a repository of attention and collective unconscious. Thus, culture is no longer associated with cultural features that participate in patterns rooted in meaning (tradition, values, institutions, etc.). Culture has become the meta-pattern, patterns founded through algorithmic agency, thus revealing the deep mathematical pregnancy and virtuality in culture.

In syntony with Stiegler's (2013) analysis, a resurrection of the human is a return to the spirit. The cultivation of the question of the spirit shall be understood, in this context, as expansion and infinite potentiality of consciousness. This is transindividuation itself mediated by the process of technological individuation outcoming *cultural technologies* or *technologies of spirit*: "The challenge of any process of psychic, collective, and technical (or technological)

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141 Such abstraction manifests "the power impulse of universality that manifests a high degree of internal resonance of the system" (LPH, 273).

142 Simondon expressed something similar in the following terms: "if human progress seems to us identifiable with technical progress, it is because human progress, in our days and in our civilization, is engaged in the development of techniques" (LPH, 270).

individuation is to constitute its motive, that is, its desire" (Stiegler, 2013, p. 121). This has been reinforced later by himself: "What remains unthought here, however, is technics insofar as it is the condition of the constitution of desire itself" (Stiegler, 2014, p. 39). Desire is that which oscillates between the calculable and the incalculable (Stiegler, 2014, p. 36). The opening of technicity and sacrality contains within the opposites: the calculable and the incalculable: "it is by calculating that we encounter the incalculable" (Stiegler, 2013, p. 119). We are faced with a calculable computational reality whose networked extension becomes ungovernable, against an incalculable subjective reality whose domain is, by better or worst means, governable. We shall be aware of a culture no longer driven by cognitive technologies designated solely as causes of the spiritual misery, of regression, of desindividuation. A new civilizational model concerns technology as the question on the spirit/consciousness/awareness itself, not without it.

By entering the cultural field, machine learning acquires the character of a theory of values, we can consider it an allagmatic theory[143] (AG, 671). Today the theory of operations entails more than feedback system operations, it opens to a crude relation of the cultural features represented as *feature vectors* or *user embedding* where a new production of psychopolitics is taking action: change of values, modifications of emotions and behaviors, self-conception, preferences, political opinions, aesthetic preferences, among others. The integration of machine learning in culture reshapes the cultural models and patterns of our times and, as Simondon left it quite explicitly, bears increasing metaphysical motivation (Appendix).

[143] It is worth to notice that such a resemblance between the science of operations and machine learning does not meet all the demands of the ontological theory of allagmatics (axiontological) as proposed by Simondon.

Appendix

AI Metaphysics

Perfectius est quod involvit plus realitatis.

It is more perfect that which involves more of reality

Gottfried Leibniz, *De affectibus*

CHAPTER IX

Automated technology and the problem of representation

§1. Rebuilding the virtual image of thought from a metaphysical perspective

Metaphysics can be synthetized as "the attempt to conceive the world as a whole by means of thought" (Russell, 2015, [c. 1910], p. 1) or as it is found since Plato's *Timaeus*, the enterprise of binding being to the totality (Badiou, 2005 [c. 1988], p. 8). Metaphysics shares with the beginnings of artificial intelligence some of the holistic and systematic claims around the exercise towards process-thinking, that is to say, the construction of general-purpose models to represent the world. According to Bertrand Russell, the human impulses towards metaphysics were responsible for leading some towards mysticism and others towards science[1] (2015, p. 1).

Precisely, in the early history of AI, the metaphysical impulse became the source of inspiration for one of the first philosophers and mathematicians who combined the mystical path with automation, Ramon Llull[2] (circa 1232-1316). Through his well-known *Ars magna*, Lull applied the influence of Aristotle's logical relationships in a paper of concentric circles made up of three discs which, when rotated, could combine the *Dignities*, the attributes of God (*Prima Figura*) with the attributes, categories and the relationships of human thought (*Secunda Figura*), (see figure 22). This mechanical apparatus was conceived for the religious and political purposes of converting muslims to christianity through logic and reason (Nilsson, 2010, p. 20). But even more, this design was the first device able to fix thinking on a series of signs that

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[1] One can regard that Simondon succeeded in bringing together both impulses, by means of his conceptualization on sacrality and technicity and with his philosophy of individuation (Sect., Part I).

[2] Cf., Fidora & Sierra (2011). Also see, Pepler & Peers (1946).

represented the logical statements (axioms) about christian doctrine from which conclusions and answers about all possible "statements of God" could be obtained[3] (theorems).

Llull's system was not only a first step towards the combination of artificial memory and performances within the *symbol*, that is to say, the *automatization of thinking,* but also one of the major influences (see figure 21) of the great metaphysician and computational pioneer from the 17th century, Gottfried Wilhelm Leibniz (1646-1716), co-inventor of the notation for the differential and integral calculus. The conversion of the disputes of thinking into the universality of the symbol was synthesized under the name of *Characteristica Universalis* (see figure 22). This was designed to bring thinking itself to an end, that is to say, the end of the debates between philosophers and the beginning of calculation as that which could decide the truth or falsehood on any dispute. Leibniz imagined the debate of philosophers of the future with the beginning of the following sentence: "Let us calculate" (Russell, 2015, p. 79).

Leibniz's predecessor of his calculating machine, *Leibniz wheel* (1671), was the *The Pascaline* from Blaise Pascal, a calculating machine that adds and subtracts, also known as "the calculating box of Pascal" as Leibniz himself called it. Besides addition and subtraction, *The Pascaline* (see figure 23) could also multiply and take roots (Russell & Norvig, 2016, pp. 5-6). This machine brought together the principles still considered, at that time, fairly metaphysical, such as geometry together with mechanics and both in relation to physics. Pascal gathered these principles in terms of a holistic and infinite way. For the latter, he considered it as the opened infinity towards two directions where they touched and met, thus conforming the spherical*,* that is, the unintelligible itself which is God. Michael Keefer refers to Pascal's observation of the infinity and quotes him in the following manner:

> It would, he says, take the same infinite capacity to reach nothingness that it would take to comprehend the whole. The two extremes of infinite immensity and smallness «se touchent et se réunissent à force de s'être éloignées et se retrouvent en Dieu, et en Dieu seulement» (Keefer, 1988, p. 305).

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[3] However, this metaphysical scheme should not be confused with access to the ultimate truths. The influence of the negative theology of Dionysius the Areopagite in Llull implied the possibility of knowing divine attributes through predicates but the impossibility of gaining access to their nature due to limitations of human capabilities. Cf., Priani, E. (2021).

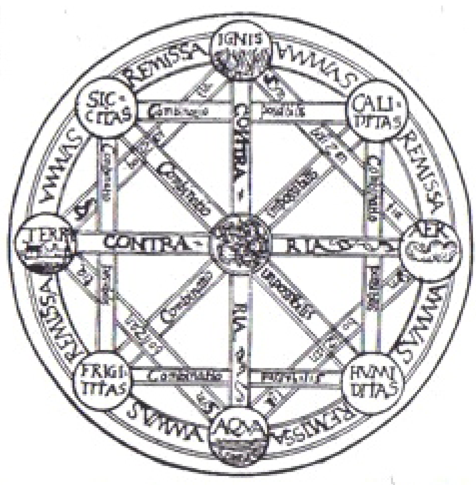

Figure 21. Ramon Llull's Ars Magna
Public domain

Figure 22. Leibniz's Characteristica Universalis
Public domain

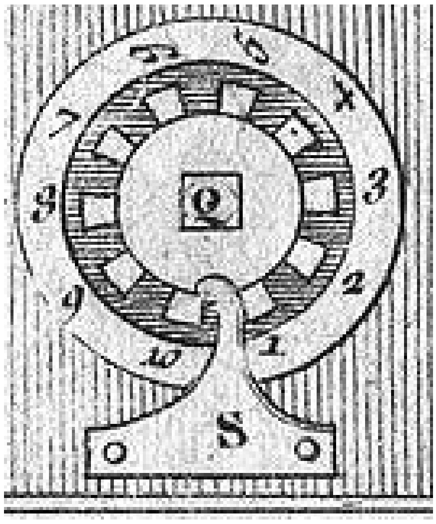

Figure 23. Pascal input's wheel of The Pascaline
Public domain

Why is it typically employed the concept of "thinking" instead of "mechanizing calculation" when referring to automated machines? This question can be retraced to the beginning of many arduous and still open debates between scientists and philosophers. Between those who consider the *Characteristica* or *Lingua Universalis* as part of Leibnizian mysticism[4] and those who consider it as a clear and feasible possibility. Regarding the latters, is that of the other 20th century most northworthy mathematician and computing pioneer[5], Kurt Gödel, who became obsessed with Leibniz's *Charactersitica* as that which could produce a revolution in mathematics (Dawson, 1997).

The strong presence of spherical designs[6] [7] (*sphaeritas*), as can be appreciated in the figures above, were to be found in the three pioneers of automation: Llull, Pascal, Leibniz. Paradoxical as it may be, *automated sphaeritas* are to be considered metaphysical and mechanical at the same time. Specially, in Leibniz's case, the *Characteristica Universalis* is a problem of representation of knowledge, hence, not able to be reduced to a logical problem-type[8]. This system of symbols was not intended to replace words but to replace ideas themselves. The metaphysical scheme responding to such a model does not take the epistemic a priori of language as the given but rather seeks an artificial or synthetic language appropriate enough to represent the content of an underlying numerical reality (Jaenecke, 1996, p. 88). In this sense, Leibniz, like the Pythagoreans, argued that "the deepest mysteries lie concealed in numbers" (Paleo, 2016, p. 1). Hence, initially, the automated access to mathematics accompanied by metaphysical principles (able to dissolve the aporias of materialism[9]). This was regarded to be the key to access to the deep, proto-model theory of ideas and universal-collective ontologies. Following Russell, the pure Leibnizian-computational task of

[4] Cf., Parkinson (1966).

[5] By accomplishing his *Incompleteness proof*, Gödel has traced the essential paths of recursive functions in number theory. Cf., Hofstadter (1994, p. vii).

[6] Pascal Chabot also analyzes the *spherical sense* of universality practiced by the encyclopedic spirit of the 18th century: "The Encyclopaedia of Diderot and D'Alembert (1751-72) [...] encompassed all that was known of reality. Its etymological origins, from the Greek κύκλος (kuklos), 'circle', reflected the ambitions of its creators: to assemble all the world's knowledge within its sphere" (Chabot, 2003, p. 25).

[7] For pre-Copernican medieval mathematical studies on the spherical understanding of the universe refer to Sacrobosco's studies: Cf., Valleriani, M. (2020).

[8] In line with this argument, Cf., Jaenecke, 1996.

[9] Leibniz, distancing himself from the materialists, pointed out in his *Discourse on Metaphysics* (1686) that material bodies and the properties of matter from which the laws of extension and motion are obtained, i.e., mathematically expressible physical laws, do not explain the final cause (the why) of these laws of matter. Underlying this is Leibniz's metaphysical principle, an immaterial force that is neither mechanical nor geometrically measurable and which responds to God's will.

accomplishing universality within the symbol was only achieved much later by Giuseppe Peano (1858 - 1932) at its highest level:

> The great master of the art of formal reasoning, [...] Professor Peano, of the University of Turin. He has reduced the greater part of mathematics [...] to strict symbolic form, in which there are no words at all. [...] For instance, if we wish to learn the whole of Arithmetic, Algebra, the Calculus, and indeed all that is usually called pure mathematics (except Geometry), we must start with a dictionary of three words. One symbol stands for *zero*, another for *number*, and a third for *next after*. [...] All future symbols are symbolically explained by means of these three (Russell, 2015, p. 78).

In its incipient stages of modern mathematics, mathematical calculation was designed to respond to a manipulation of signs by making deductions according to the formal properties obtained from the (grammatically well-formed) rules within a system. In this vein, Eugene Wigner in his famous article from 1960 wrote:

> I would say that mathematics is the science of skillful operations with concepts and rules invented just for this purpose. The principal emphasis is on the invention of concepts. Mathematics would soon run out of interesting theorems if these had to be formulated in terms of the concepts which already appear in the axioms (Wigner, 1960, p. 2).

In any "formal axiomatic system", the algorithmic operation that runs with the selected signs is devoid of meaning and it is only at the moment of assigning (arbitrarily) to these signs and terms a certain meaning that they become an "interpreted axiomatic system" (Klimovsky, 2000, p. 35, own translation). Oddly, from the arbitrariness of convention, mathematical methods are born. Consequently, the number of axiomatic systems could be infinite and also, forcing them to make a system more complete is also another possibility[10]. After the convention of fixing axioms, theorems of the interpreted system are obtained. If, after the interpretation, the axioms are transformed into true statements, one is faced with a "model". The mathematical

[10] On the new logic for the axioms of infinity. See the postulate: V=ultimate L .Cf., Wolchover, N. (2013).

nomenclature indicates that model means that the axioms “have been transformed into truths” (p. 37, own translation)[11].

Therefore, mathematical calculus can be regarded as the potentially infinite system of references for computable and uncomputable realities[12] (numerical as well as non-numerical[13]) in which each model of the system at issue describes a structure that can be found in one of the two following ways: whether as reflected in reality, that is to say, as having objects of reference (applied mathematics) or not representing any object from reality at all (pure mathematics)[14]. In this sense, returning to Russell’s quotation about Peano, when he indicates that Peano’s system is a very *pure* system in which “there are no words at all” he is referring to a purely syntactic system without objects of reference. In its applied sense, although there is no object in the world that is not susceptible to mathematical treatment (Klimovsky, 2000, p. 49), not all mathematics can be reduced to observable phenomena. Hence, mathematical calculation, in its general sense, does not behave as a receptive system of information but as: “a penetrating instrument that attains the grandest truths, all of which lie beyond the reach of our five bodily senses” (Cohen, 2007, p. 3).

Mathematical reality contains mathematical objects and their potentialities, their relations. A mathematical object is associated as well to Pythagoras’ treatment of numerical logic: “Thanks to his genius numbers were no longer merely used to count and calculate, but were appreciated in their own right” (Singh, 2011 [c. 1997], p. 7). In this view, mathematical objects imply a reality able to be connected by means of abstract structural networks that progressively link them up (an example of this are the formalized structures of “category theory”). In a strict philosophical sense, this pure view of mathematics, implies that numbers have an ontological reality different from the sensible reality. However, as we can already find in the last Plato, (to whom Simondon himself will find traces of a theory of the becoming as we

[11] This has also been presented in: Sect., Chapter V, §1., 1.1: *The problem of methodological unity in machine learning: An introduction to the concept of model*

[12] There are two kinds of infinites when addressing the computation upon real numbers: a computable infinity and an uncomputable infinity. The latter, as contrary to the former, includes most of the real numbers not able to be computed for a terminated algorithmic process. I extend this topic in my work (2021): “Ambivalence in machine intelligence: the epistemological roots of the Turing Machine”.

[13] For example, among non-numerical entities we can find abstract algebra, algorithms, operators, and Cantor sets.

[14] There are cases, such as the one cited by Daniel Cohen, in which pure mathematics leads to the prediction of physical phenomena without prior observation, as it is the case of the discovery of the planet Neptune in 1846. Cf., Cohen (2007, pp. 1-42).

will describe later), mathematics does not dissociate itself from physics, but rather, converges with it allowing, in this way, to unfold effective theories.

The symbolic manipulation of mathematical objects can be regarded, at a general level, as the very first modern manifestation of a platonic root on the knowledge of the *infinitude through the finitude*. The finitude is expressed through the formalization of terminated procedures (computational/ mechanical/ effective procedures) which fundamentally deals with the theory of numbers (arithmetic) and that seem to correspond to the Platonic-Pythagorean tradition (Klimovsky, 2000, p. 26). It is, precisely, through the concept of *infinity* that we would like to briefly explore the problem of automated technology and representation.

§2. Metaphysics of calculus: infinity and automation

Infinity is a non-numerical mathematical concept which, in philosophical terms, is regarded as the *apeiron* (unlimited or indefinite) and whose origins, according to Plato's *Philebus*, dates from the Pythagoreans and that Simondon himself recovered from Anaximander. This unparalleled excess can only be masked under a symbolic veil (∞) while never being deciphered by the limits of logical formalism (as initially noted by Cantor and later confirmed by Gödel) nor by the limits of experience itself. We have no empirical experience of the infinite as theorized by both: rationalist and empiricist traditions. The concept of infinity has been so greatly detested by empiricists that Berkeley and Hume even denied its existence (Moore, 2019).

In a sense contrary to the computational commands where "if-then" statements predominate, Russell (2015) pointed out, for infinity there is no such thing as the "next after":

> The interval between one moment and the next would have to be infinitesimal, since, if we take two moments with a finite interval between them, there are always other moments in the interval. [...] This might be thought to be a difficulty; but, as a matter of fact, it is here that the philosophy of the infinite comes in, and makes all straight (Russell, 2015, p. 83).

Nonetheless, infinity does play a fundamental role in the birth of digital computation since it is by means of transfinite numbers in Cantor's set theory along with its paradoxes and the demonstrations of its limitations in Gödel's proof (1931) that Alan Turing was able to conceive the first prototype of a digital machine. Such a problem implies the limits of arithmetic and algebraic calculation, that is to say, to the study of what an algorithm can and can not solve.

The digital machine has no head, it is born as an annihilation of the infinite, the machine is *akephaloi*, without representation or image of thought. For this, there are two technical reasons where digital machines hit infinity. In order to formulate this we must briefly address two basic aspects of the Turing machine (TM)[15] or logical computing machines (LCM) as Turing himself called it. *In the first place*, Turing worked on two fundamental problems of mathematical logic: one of them was the so-called "Cantor's diagonal", the other one, was the metamathematical proof known as "Gödel's Incompleteness Theorem". The former identifies that the infinities of the real numbers are larger than the infinities of the integers, namely, there are enumerable infinities and non-enumerable infinities. For Turing, this was translated to the fact that there are computable and non-computable infinities (see footnote 13). The latter came from Gödel's conclusions from where Turing obtained that it is not possible to logically compress all mathematics in order to decide the truth of all its statements[16].

Up to this point, the picture that Turing obtained was that *mathematical* thought can not be algorithmically compressible. Thus, he concluded that there is no algorithm or "effective procedure" able to compress the whole of all mathematics because mathematics themselves (arithmetical concepts) transcend the true-false well-formed designation of reality. Still, in return, he developed the procedure for the part of mathematics that is computable. With this,

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[15] Turing's machine follows the basic set of instructions of a program (left, right, suspend or symbol execution) which is nothing more than a finite alphabet of expressions whose instructions come from a flesh and blood human being with pencil and paper. Here one could even sympathize with the idea that the prototype of the computer has been the human, i.e., it was the human who imitated the digital machine before the machine itself existed. In my paper (2021), I offer a detailed description on the working and the context behind the Turing machine, from where follows:

> This "essentially complex machine" (Blanco, 2013) is made up of three basic elements (tape, head, and program) which constitute what we recognize today in any electronic device under the names of memory and microprocessor, which reads and executes the programs. The scanning head reads the basic set of previously set-up instructions in order to adapt and modify its "internal state". For instance, if the internal state is 1, then move to the left and replace it with 0 and then move forward to the right and continue or break the process. Thereby, the machine adjusts its internal state by moving forward along the instructions chain until it produces the desired output and terminates. (Prado, 2021, p. 62).

[16] To understand the philosophical problems regarding Gödel's incompleteness theorem and the debate on the mechanization of mathematics, Cf., Wright (1993).

Turing inversely solved Hilbert's famous *Entscheidungsproblem* (that is to say, the algorithm that Hilbert was asking for did not exist) giving in this way birth to the very genesis of machine cognition. The very epistemological crisis in the foundation of mathematics gave rise to the origin of any modern digital computer.

In the second place, at the operative-performative level, the Turing machine nests a *potentially infinite* tape (memory) of fixed notations read by the scanning head in order to modify the program's behavior (explained in footnote 16). Yet, in strict and factual terms, we know that the tape is always finite simply because matter is not factually extensible to infinity. Therefore, the impossibility of the TM to "incorporate" indeterminate forms of the type: ∞ - ∞, ∞ / ∞, ∞ / ∞, ∞ or infinite numbers in a finite memory (Sergeyev, 2021).

Perhaps we may encounter that the very problem of infinity entails the problems of representation of thinking itself. In order to grasp its significance, from what is left in this section, we want to emphasize and relate: initially, the brief historical aspect of the formation of the concept of infinity ranging from the ancient Greeks to modern mathematics where the debates around the notion of the *infinite* addressed by Georg Cantor (1845-1918) come in. Subsequently, the problem of finite/infinite representation which so much Deleuze and Badiou derive from Cantor's position. This opens in the next section a glimpse into a new metaphysical enterprise around mathematics: *a virtual platonism*. What do we understand under the expression of virtual Platonism? A "mathematics of operations" and not a mathematics of structures, based on operations of becoming and not on axiological a priori normativity: "The metric of idea-numbers, as conceived by Plato [...] seems to express, in its author or authors, an effort to theorize the operations of becoming" (EC, 193, own translation) wrote Simondon when reflecting on cybernetics. Models or archetypes[17] participating in relations and numerical distributions of patterns is a very platonic event, or at least, from the context of artificial intelligence, it is what we can consider as *virtual Platonism*. That is, a metaphysics of mathematical-based relations that incite the wounds of our time.

2.1. A brief history of infinity

[17] Sect., Part I, Chapter IV.

The history of infinity has a Greek origin which can be divided between: on the one hand, the treatment of infinity through the omission of time in space (manifestation of the thesis of the univocity of being) and, on the other hand, the treatment of infinity in relation to time (manifestation of the thesis of the actuality and potentiality of being). To the former belongs the well-known Zeno's paradox [18] found in Plato's work, *Parmenides,* from where not only follows the non-existence of motion but also agrees with the position of the "univocity of being" defended by Zeno[19]. From a different perspective, to the latter, belongs, as distinguished by Aristoteles[20], the concept of infinity in its relation to time: the actual infinity *aphorismenon* which "exists as some point in time" and potential infinity[21] (*apeiron*) (Moore, 2019). Beyond the nebulousness of the Greek definition, the concept had two different applied associations: on the one side, the geometric aspect of the infinitesimal difference of the circle with respect to the polygon[22] and, on the other side, the arithmetic expression of infinity revealed through the square root of two as an irrational number[23].

The ambivalent concept of the infinite replicates a dialectic practice, on the one hand, in its geometric-spatial aspect, it can endlessly replicate the patterns (as in the case of the Hilbert curve or the recursive Mandelbrot set), but, on the other hand, in its arithmetic-numerical expression, it may not replicate any pattern at all (such is the case of irrational numbers and those mathematical expressions that are beyond the domain of the computable reals).

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[18] Zeno proves that giving an initial advantage in favor of the tortoise (due to its slowness), each forward step of Achilles will always be surpassed by the forward steps already made by the tortoise. Consequently, Achilles cannot reach the turtle. Thereof the paradox of an infinite process (where it is proven that the tortoise is always first in the race). Still, it is a process that can, halt/ terminate and therefore, reach an end. According to Russell, the first trace of a philosophy of infinity is found in the figure of Eleatic Zeno (2015, p. 80).

[19] Other supporters of the univocity of being are: Parmenides, Spinoza, Duns Scotus, Deleuze.

[20] Cf., Aristotle's *Physics*, Book III and *Metaphysics*, Book 9.

[21] The contemporary mathematician and logician, Stephen Simpson, acknowledges that the community has forgotten these distinctions and argues that actual infinity does not really exist in the mathematical universe and that most theorems in mathematics can be proved using potential infinity. Wolchover, (2013). Also, Cf., primitive recursive arithmetic (PRA) and Skolem arithmetic.

[22] That is to say, as the sides of the polygon increase, the closer it becomes to resembling a circle. As I underlined in another work (2021), this was part of the "obsessive activity" of the Greeks to square the circle which they called tetragonize (*τετραγωνίζειν*). Cf., (Petzold, 2008: 13-35).

[23] The last-mentioned event led to the famous murder of Hippasus of Metapontum, drowned in the depth of the sea, which concluded with the ruins of the Pythagorean school. Cf., Singh, S. (2011).

It is nonetheless, since Leibniz's and Newton's invention of the Infinitesimal Calculus[24], that a metaphysical enterprise has been opened while crossing different and several mathematical debates of the 20th century: *the finite manipulation of the infinite*[25], e.g.,: in the Leibniz formula for π (with an infinite pattern of fractions), Euler's analysis of infinity (through his definition of the exponential function), Riemann's infinitesimal conception in geometry (where space is defined by the value between two points that get infinitely close to each other), Dedekind's infinite set (with a bijective relation between two infinitely countable subsets), Georg Cantor's transfinite numbers in set theory (in which one can compare infinities greater than others), Levi-Civita field (a system of infinity and infinitesimal quantities), Hardy's order of infinities (the behavior of real functions at infinity), Gödel's consistency proof (for the Cantor continuum hypothesis)[26], Hilbert curve (with infinite replication of the pattern produced between the curves), and the list may also be unbounded. But it was in the middle 19th century and beginning of the 20th century when mathematical objects and infinity took off and were largely welcomed by the philosophical terrain. The latter recognised, particularly in Cantor's platonism[27], a crucial feature that seems to offer a new form and a critical debate for contemporary philosophy between the opposites finite/ infinite states of representation.

By the end of the 19th century, the most important stage for the classification of mathematical objects was opened up: Cantor's set theory. In a broad sense, it consist of: a set (A) which is a cluster of objects of well-defined properties, these objects besides being members ($x \in A$) of the set, can also be a set themselves inf $=\{A \mid A$ is an infinite set$\}$. A set does not correspond to a numerical or geometric entity, a set is what groups together mathematical objects. With this, Cantor gave birth to a new environment for mathematical objects able to

[24] Contemporaneous to both, the English mathematician John Wallis (161-1703), creator of the symbol ∞, has also partially contributed to the infinitesimal calculus. To understand the intellectual property on the invention of calculus, that is to say, whether it was Leibniz or Newton who first invented it, it is important to review the relationship not only between Wallis and Leibniz but also the relationship between Wallis and Newton. For the first case: Cf., Hofmann (1973). For the second case: Guicciardini (2012). Guicciardini (2012, pp. 1-16) points out that Wallis contributed as an editor of Newton's work by integrating and printing Newton's heuristic methods of algebra in his works, Algebra (1685) and Opera (1693-99). His masterpiece is *Arithmetica Infinitorum* (1656).

[25] In the subtleties of mathematics the notion of infinity also depends on the notion of natural numbers.

[26] Also, Hilbert pioneered Cantor's *continuum hypothesis* debate, it was selected by Hilbert as the number one problem of the 23 unsolved mathematical problems (Sergeyev, 2013, p. 5).

[27] According to Kai Hauser, Cantor's most profound philosophical contribution to transfinite numbers is found in his work: *Grundlagen einer allgemeinen Mannigfaltigkeitslehre.* Cf, Hauser (2010).

enter into relationships with each other. Thereof, enabling the finite manipulation of the infinite and the generation of new classifications and classes. This classification constitutes an ontological collection of objects within a whole, an idea, a model which is profoundly bound with Plato's *εἶδος* as Cantor himself described:

> For by a "manifold" or "set" I understand in general every Many which may be thought of as a One, i.e., every totality [Inbegriff] of determinate elements that can be united by a law into a whole. [...]
> And with this I believe to define something related to the Platonic *eidos* or *idéa* (Cantor in Hauser, 2010, pp. 783, 784).

But how did Cantor demonstrate this "Many" later unified by the One?: the answer lies in "the diagonal proof" where Cantor established a correlation between the set of natural numbers at infinity and the set of real numbers between 0 and 1. If such a list of correlations between both infinities would be given, it is assumed that all the numbers of each set respectively are expressed. When Cantor applied the diagonal proof[28] he proved that the set of infinities of the real numbers is greater than that of the natural numbers. Therefore, some "Many" were able to be rearranged and clustered as a "One" and enter into a relational network with other "Manys" allowing an ever extended greater unity. This theory led to the collapse of the basic principles of logic and its informative meaning (such as Aristotle's principle of the excluded third). This was the beginning of a never-ending crisis in the foundations of mathematics which divide mathematicians, now and then[29].

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[28] This consists in: adding a digit to the first number, then another to the second of the second row then again a digit to the third of the next row and so forth, one arrives at a number that is not in the list of correlations formulated in the first place.

[29] On the one side, there were the intuicionists led by Poincaré who considered Cantor's set theory a sickness that should be removed from the field and claimed mathematics as a product of human reasoning. The later-borned neointuicionist school led by Alfred Tarski wanted to modify logical principles and structures derived from Aristotle, Frege, Russell. And, less radical than these, Russell himself worked on his logical atomism as a reformulation of the structure of these problems (Klimovsky, 2000, pp. 54- 55). On the other side, there were those who searched for a more absolute logical model to support the existence of greater infinities and their mathematical objects, these were the formalist led by Hilbert who even claimed: "No one should expel us from the paradise which Cantor has created for us" (1926, p. 170). Cantor, on a path similar to that of Socrates and Boltzmann, suffered from the opprobrium of the scientific community of his time and decided to put an end to his life. The

The problem of the representation between the infinite/finite mathematical objects prompted the debate on the construction of a formal logical model able to axiomatize the objects of study in mathematics. The claim and the various attempts carried out by Hilbert's followers, known as *logicists*, tried to give formal support to mathematics through Frege's logic (basic rules of logical deduction found in his work, *Begriffsschrift* (1879)), which finally led to a very epistemological crisis in the foundations of mathematics.

The aforementioned attempt led to two different and very well-known self-referential proofs: the first one was the emergence of the recursive antinomy presented by Russell (self-referential paradox)[30], where the British mathematician and philosopher questioned whether the set that contains all sets which do not contain to themselves, belongs or not to itself. This drove to the following paradox: if the set contains to itself, it does not belong to itself and if it does not contain to itself, it does belong to itself. The second self-referential problem was the metamathematical proof about the impossibility of encompassing mathematics by means of formal deduction: *Gödel's Incompleteness Theorem.* The automation of thinking or the algorithmization of mathematical thinking was born then, in the form of a syntactic symbol-manipulation project within the field of mathematics whose aim, according to Gödel, was to accomplish the following three properties:

i) To prove the truth of the statements from the axiomatic system (complete), i.e., is it possible to demonstrate that any mathematical statement is true?
ii) To prove that it is free from inherent contradictions (consistent), i.e., is it possible to demonstrate that $\perp(A) \Rightarrow A$ is not possible within the system?
iii) To have an effective method/ algorithm able to demonstrate that the statements are deduced from the axioms created in the first place (decidable), i.e., is the given formula provable or not?

Behind these questions, the fate of the symbolic automation of thinking, Leibniz's *Characteristica Universalis* and the whole logicist project of the late 19th and beginning of the 20th century was at stake. Gödel's results demonstrated the very void upon which mathematics was settled: if the formal system is consistent, then it is incomplete or if complete, then it is

defamations against his theory regarded it as illusory, as a corrupting influence on young people, and part of a disease that should be eradicated in the future. Cantor died in a psychiatric institute.

[30] Later, this complex dispute brought by set theory had been largely solved by the axiom III of Zermelo set theory where ideas like the set of all sets is no longer a set.

inconsistent. The problems inherent in the foundations of mathematics, i.e. the limitations of the logical tools[31], the absence of the algorithm sought by Hilbert in his "*Entscheidungsproblem*", disclosed the disarrangement between: *reality, symbols, and mathematics.*

This propels us to consider the fundamental problems already present in virtual platonism: "within mathematics reality fulfills its true function: to provoke thought." (Bachelard, 1984, p. 5).

2.2. A becoming of mathematics: *virtual Platonism*

It was Cantor's platonism what led to consider a «metaphysics of calculus» as a possible solid ground weather to be broken by means of the concept of *difference* manifested in the expressions of mathematical functions (Deleuze)[32] or to be revived by means of the ontological questions of *being* in mathematics itself (Badiou)[33]. Particularly, Deleuze's interest in the

[31] On that account, the limitations of Frege's logic also evidenced the power of self-referentiality in the field of mathematical logic (later used in the theory of computability through the implementation of the method of recursion).

[32] Deleuze wrote:

> It is difficult to see how the limit immediately cuts into the infinite, the unlimited. [...] Later, Cantor provides this theory with its mathematical formulas from a double-s-intrinsic and extrinsic-s-point of view. What the theory of sets does is inscribe the limit within the infinite itself [...] In spite of the explicit attempt by Cantor to unite philosophical concept and scientific function, the characteristic difference remains, since the former unfolds on a plane of immanence or consistency without reference, but the other on a plane of reference devoid of consistency (Gödel) (Deleuze, 1994, pp. 120- 121).

[33] And Badiou refer to this in the following manner:

> [F]or the philosopher, the decisive break - in which mathematics blindly pronounces on its own essence - is Cantor's creation. It is there alone that is finally declared that, despite the prodigious variety of mathematical 'objects' and 'structures', they can all be designated as pure multiplicities built, in a regulated manner, on the basis of the void-set alone. The question of the exact nature of the relation of mathematics to being is therefore entirely concentrated - for the epoch in which we find ourselves - in the axiomatic decision which authorizes set theory (Badiou, 2005, p. 6).

question about the real existence of the infinite (realized through his analysis on the theory of differential calculus) lies in the fact that the infinite completely overflows (*des-borda*) the frame of representation:

> The real frontier defining modern mathematics lies not in the calculus itself but in other discoveries such as *set theory* which, even though it requires, for its own part, an axiom of infinity, gives a no less strictly finite interpretation of the calculus. [...] It is precisely this alternative between infinite and finite representation that is at issue when we speak of the «metaphysics» of calculus. (Deleuze, 1994, p. 176, own italics).

The method of calculus accounts, on the one hand, for the existence of infinity itself and, on the other hand, for the fact that it exceeds the limits of any cognitive scheme (of the representational type or not). The *image of thinking* can be regarded as that which exceeds the limits of its configurations, an *infinite excess* (in Nancy's terms) that updates itself as it reaches a threshold (becomes *oversaturated* in Simondon's, *limit dissipation* in Deleuze's lexicons). This becomes a key assumption to weave the abstraction of "cognition" from the perspective of *potentiality* or the automatization of mathematical models from the perspective of *evolution*.

After the downfall of a purified view of mathematics in terms of its axiomatic link to formal logic, it was necessary to clearly set the limits of logic with respect to mathematical objects and take sides against the inheritance received by the *Logicist* group. This attempt gave rise to a new and contemporary metaphysical contribution to mathematics[34], which, like the functioning of the mind itself, responds to dialectical, creative and dynamic tensions. Albert Lautman has led this proposal, both from a mathematical and philosophical point of view. As outlined by Jacques Lautman:

> Gilles Deleuze (1994 [1968], chapter 4) and, more recently, Alain Badiou (2005 [1998]) appear to be the only ones to have made explicit a strictly philosophical use of his work [Lautman's work], outside of a strictly epistemological context or the history of the discipline (2011, p. xv, own bracketing).

[34] Besides the notorious differences in their fields of study, some exceptions of the second half of the XX century, influenced by the readings of Gödel's and Lautman's platonism, made possible an emergence of a relational and mathematical understanding of reality, particularly: Bachelard's epistemology, Deleuze's and Badiou's ontologies.

In this sense, the dissociation between logic and mathematics and Badiou's association between metaphysics and mathematics sheds sharp light:

> The productive consistency of the thought termed 'formal' cannot be entirely due to its logical framework. It is not -exactly- a form, nor an episteme, nor a method. It is a singular science. This is what sutures it to being (void), the point at which mathematics detaches itself from pure logic, the point which establishes its historicity, its successive impasses, its spectacular splits, and its forever-recognized unity (Badiou, 2005 [cf. 1988] p. 6).

From a metacontinental perspective, Cassou Noguès explains that there are at least two views of Platonism in relation to mathematics, the first one is a "naive Platonism" corresponding to the "purified view" in which mathematical objects represent copies of ideal and static realities identical to themselves, the second one is a "virtual Platonism", in which, partially, the theories of Gödel, Lautmann, Cavaillès, and Bachelard participate and where there is a process of constant movement, transformation, *devenir* throughout the search for resolutions. For virtual platonism, mathematics becomes a creative process where there is more than rigid axiomatic structure[35] as found in the beginning of the 20th century at the foundations of arithmetic conceptualization.

After a long winter of metaphysical deconstruction, the virtual machine, that is, that which runs in the physical computer, seems to bring about the spring: it does not contain its forms (programs and algorithms) in the realm of the sensible but in information processes and mathematical models. This is called "technical transcendence" by Capurro and can be read as an explicitly Platonic gesture: "In contrast to Plato the pure mathematical forms are now at the heart of a techno-logical engine, the computer" (Capurro, 2003). In this line, we can also find Mark Coeckelbergh who briefly wrote:

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[35] Crispin Wright outlines the problem of the partial description of arithmetics on the subject matter of analysis and points out:

> We don't come by our basic arithmetical concepts by doing formal number theory; and the informal understanding which we acquire of those concepts suffices not merely to give the Peano axioms a cogency which would be quite messing if they had anything of the character of stipulations (1993, p. 321).

> More generally, when AI and related science and technology use mathematics to abstract more pure forms from the messy material world, this can be interpreted as a Platonic program realized by technological means. The AI algorithm turns out to be a platonic machine that extracts form (a model) from the (data) world of appearances (2020, p. 24).

The pivotal role of building and automating models of the world perhaps can be played out in this *virtual Platonism.* In virtual platonism, it is the algorithms that automate models. Maybe this even evokes the very dynamic process of individuation within mathematics itself, what we could call, following Simondon's spirit and in Cavaillès terms a: *becoming of mathematics*. Through this gateway, we draw closer to a possible genetic metaphysics behind the calculating automation of machine learning. In this sense, mathematics operates through an exercise that is relational rather than formal, approximate, and uncertain rather than accurate and strict[36]. Lautman asserted (1958) when he expressed that behind the identification of logic with mathematics (e.g., as also performed by Wittgenstein and Carnap) lies the very instrumental idea of mathematics as a tool with no relation to what it is expressed. When mathematics loses grounds with reality, this eliminates the very idea of a mathematical reality, Lautman wrote:

> Only empirical propositions refer to an objective reality, and mathematics is only a system of formal transformations allowing the data of physics to connect to each other. If one tries to understand the reasons for this progressive disappearance of mathematical reality, one may be led to conclude that it results from the use of deductive method (2011, [1958], p. 87).

Mathematical structures, are immersed, like a work of art, into the virtual, sometimes even losing their objects of reference from the world. The mathematics behind the models that are able to potentially construct reality (e.g., by means of a prediction) are not those referring to concrete empirical objects but to the relationships of the attributes belonging to the objects themselves. The general reference to automated mathematical models reopens the question of

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[36] Lautman retrieves in many of his examples to the mathematical theories of the infinity against formal rigid transformations such as the deductive method: "Irrational numbers, the infinitely small, continuous functions without derivatives, the transcendence of e and of (pi), the transfinite had all been accepted by an incomprehensible necessity of fact before there was a deductive theory of them" (2011, p. 88)

how the numerical approximation to reality brings us closer to the limit of how we ourselves classify the objects of the world.

For a relational and creative view of mathematics Bachelard offered a great epistemological foundation that, although considered under the context of microphysics, becomes an analytic useful tool when referring to current technology: "There are no simple phenomena; every phenomenon is a fabric of relations. There is no such thing as a simple nature, a simple substance; a substance is a web of attributes" (1984, pp. 147-148). The mathematical architecture of machine learning, with all the complexity and diversity of techniques and functions that these imply, is underpinned by the processes and relations of predominance established between the attributes presented in the data to be analyzed. When the data is disintegrated or deconstructed for analysis, it is primarily based on its attributes (Sect., Part II). Attributes are not empirical objects, they are abstractions, and as such, they inherently contain potentiality. Borges, had the poetic genius to express this last point in his poem *El Golem*: "in the letters of *rose* there is the rose and the whole Nile in the word *Nile*", thus concluding, in accordance with the Platonic line, that "the name is the archetype of the thing".

An automated pattern-based culture does not deal only with technical objects of the world but, even more, with the mathematical patterns born from relations that constitute its milieu in the first place. What we do to mathematics produces a cultural microcosm. The automatization of mathematics is not simply a mere technical gathering of data practices but a continued process of giving form, in-*forming* the series where both past (regressive) and future (predictive) potentialities are extracted and which allows us to see the horizon of a new cultural phase-shift.

A culture regulated and in-formed by algorithms, unlike Plato's changeless mathematical city, has the power of variability, and therefore, of becoming. With mathematics applied to all processes other than industrial and economic, that is, to the social, psychological and cultural process, today's culture itself becomes an *archetypal culture,* it becomes a model governed by numerical patterns. That is to say, not a static one as the ideal platonic mathematical city, it is rather an archetypical society based on mathematical models in a state of continuous actualization and *devenir*.

In the mature period of Platonism, Simondon saw a theory of becoming, getting, therefore, closer to virtual platonism (recall Simondon's quote: FIP, 696, 697). Particularly, as described in *Histoire de la notion d'individu* (1952-1958), the two works of Plato where the dynamics of reality are expressed are the *Symposium* and the *Phaedrus*. Later in a 1960's conference, *Form, Information and Potentials*, he referred again to the genetic becoming of the Platonic *eidos* in relation to mathematics in (p. 681):

> No doubt, Plato was not absolutely satisfied with his doctrine, since we see, due to what Aristotle left us in books M and N of his *Metaphysics*, that towards the end of his life and in his initiatory teaching Plato wanted to find a formula that could explain becoming: instead of seeking to flee from here to there, he wanted to be immortalized in the sensible. The doctrine of the number-ideas perhaps indicates a desire to discover a more precise, more essential meaning in becoming.

Mathematics as becoming or virtual platonism enables to relate perceptually heterogeneous realities[37]. And, it may leave an open door for exploration while considering that, utterly, it is the very genetic nature of beings what guides the evolution and universality of patterns throughout the universe.

[37] Simondon considered this when referring to symbolic measurement systems (II, 155).

Bibliography[1]

List of Abbreviations of Simondon's works:

HCNN	1953a	Humanisme culturel, humanisme négatif, humanisme nouveau.
CPH	1953b	Cybernétique et philosophie
EC	1953c	Épistémologie de la cybernétique
PIT	1953-1954	Place d'une initiation technique dans une formation humaine complète
PRE	1954	Prolégomènes à une refonte de l'enseignement
A	1957-1958a	Allagmatics
ILFI	1958b.	Individuation in light of notions of form and information
HNI	1958c.	Histoire de la notion d'individu
MEOT	1958d.	Mode of existence of technical objects
CN	1958e.	Complementary Note on the Consequences of the Notion of Individuation
LPH	1959	Les limites du progrès humain
FIP	1960a	Form, Information, and Potentials
AM	1960b	Attitudes et motivations
EH	1960c	L'effet de halo en matière technique: vers une stratégie de la publicité
PST	1960-1961	Psychosociologie de la technicité
API	1962	L'amplification dans les processus d'information
CI	1964	Cours sur l'instinct
CS	1964-1965	Cours sur la perception
CT	1965	Culture et technique

[1] This section is divided in: List of Abbreviations of Simondon's works; Works of Gilbert Simondon; Secondary Literature on Simondon; Specialized journals and dossiers; Specialized literature on Computation; Literature on Mathematics, Logic, and Mathematical Logic; Secondary Literature.

II	1965-1966	Imagination et Invention
IPM	1965-1966	Initiation à la psychologie moderne
PM	1968	Perception et modulation
IDT	1968–69	L'invention dans les techniques
CC	1970-1971	Cours sur la communication
NT	1970	Naissance de la technologie
LRA	1976	Le relais amplificateur
AT	1980	Art et nature. La maîtrise technique de la nature
RTE	1982	Réflexions sur la techno-esthétique

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