A Promethean Philosophy of External Technologies, Empiricism, & the Concept: Second-Order Cybernetics, Deep Learning, and Predictive Processing

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Abstract

Beginning with a survey of the shortcoming of theories of organology/media-as-externalization of mind/body—a philosophical-anthropological tradition that stretches from Plato through Ernst Kapp and finds its contemporary proponent in Bernard Stiegler—I propose that the phenomenological treatment of media as an outpouching and extension of mind qua intentionality is not sufficient to counter the 'black-box' mystification of today's deep learning's algorithms. Focusing on a close study of Simondon's *On the Existence of Technical Objects* and *Individuation*, I argue that the process-philosophical work of Gilbert Simondon, with its critique of Norbert Wiener's first-order cybernetics, offers a precursor to the conception of second-order cybernetics (as endorsed by Francisco Varela, Humberto Maturana, and Ricardo B. Uribe) and, specifically, its autopoietic treatment of information. It has been argued by those such as Frank Pasquale that neuro-inferential deep learning systems premised on predictive patterning, such as AlphaGo Zero, have a veiled logic and, thus, are 'black boxes'. In detailing a philosophical-historical approach to demystify predictive patterning/processing and the logic of such deep learning algorithms, this paper attempts to shine a light on such systems and their inner workings à la Simondon.

Keywords

deep learning; externalization; Simondon; Carnap; second-order cybernetics; Predictive Processing

This article was penned shortly before Bernard Stiegler passed and was constructed after a series of exchanges between myself and Stiegler. Although the article seeks to problematize some of Stiegler's thought regarding the philosophy of technology, specifically in regards to his theorizing neural networks and deep learning, I ought to underscore that Stiegler was a mentor and friend who always encouraged my debating and challenging his work. Thus, this article is dedicated to the life and memory of Bernard.

Introduction: Media as Externalization

The philosopher of media Bernard Stiegler is one of the most recent thinkers to propose that media objects are the externalization of something more primal and transcendental, whether it be intention, language, or cognition. Stiegler considers that the implications of the Promethean program, where collective self-mastery and active participation are imbricated within the remaking of mankind in the world, has become exacerbated in the era of digital technologies and networks. Stiegler's normatively negative position—violently poised against the possibility of a transhumanist telos of further enlightenment—is perhaps what distinguishes him most from the philosophical genealogy of technicity. Before proceeding with a critique of Stiegler, however, we must first contextualize that his thought does not exist in a vacuum and that his is only the most recent instantiation within a rich history of philosophical anthropology and the philosophy of technology that sees the human as a 'not-yet-finished' creature capable of developing itself by way of self-constituting prostheses—linguistic/semantic and technological—artificializing its environment and automating its ecology. Russian philosopher Nikolai Fedorov, an early champion of radical life extension and a precursor of transhumanism, identified this same deficiency as what moors mankind to the creative drive, the impetus to explore foreign lands and celestial spaces with the index of domination in mind. Musing on the history of human invention and *reinvention*, Fedorov remarks that:

> the spread of humanity over the planet was accompanied by the creation
> of new (artificial) organs and coverings. The purpose of humanity is to
> change all that is natural, a free gift of nature, into what is created by
> work. Outer space, expansion beyond the limits of the planet, demands
> precisely such radical change. The great feat of courage now confronting
> humanity requires the highest martial virtues such as daring and self-

sacrifice, while excluding that which is most horrible in war—taking the
lives of people like oneself (Fedorov, 1990: 96).

For Fedorov, this 'underdetermination' of overspecialization, the Promethean
anthropological-philosophical treatise, grants a level of behavioral leeway and
cognitive lability to mankind.[1] On one hand, Stiegler follows from this tradition, for
he sees such invention as inexorable from the human project but, on the other hand,
Stiegler also argues that there are catastrophic implications riddling its most recent
actualization in the realm of 'the digital' (or what he calls 'digital tertiary retentions').
For Stiegler, digital reinvention is steeped with the phenomenological erasure of
creative technical activity, where technē is no longer the project of human rationality[2]
but the engine of positive feedback loops that overdetermine and undercut creativity,
forecasting mankind's future into anomie and isolation. Such is the murmur of
Stiegler's techno-pessimism.[3]

Stiegler's fatalistic treatment thus recalls what Friedrich Kittler perhaps all too
dismissively denounced as the 'old thesis' of media—the understanding of media
artefacts as extensions of human systems/organs.[4] Yet this 'old thesis' is not merely
[5]relegated to media theorists such as Stiegler nor obscure transhumanist thinkers
such as Fedorov. In fact, it finds its philosophical roots in the birth of philosophy,
which arguably spouts forth from the consideration of the human organism as the
inheritor of lack: a remainder that is underdetermined, underspecialized, and
underdeveloped physiologically and adaptively.[6] This 'lack', the posthumanism that
haunts the human project, is precisely what innumerable philosophers have argued
motivates mankind's invention of artificial technologies, artefacts, and languages,
systematizing a recursive scaffolding of self-reference and development.

This rendering has a long lineage beginning with Plato's *Meno*. In the *Meno*, Socrates
insists that one can know nothing of virtue intrinsically and that knowledge
transpires dialectically, a byproduct of dialogue and interrogation vis-à-vis sociability
and deduction. For Socrates, knowledge is an offspring of the nature of virtue
revealing itself. Consequently, Socrates calls upon an uneducated slave from Meno's
retinue, querying whether this boy knows how to calculate the double of the area of a
square. As the boy draws a square in the sand, followed by diagonal lines, Socrates
claims that the slave 'spontaneously' recovers the solution to this problem.

Exteriorizing the calculation, technesis involves the synthesis of the hypomnesic inscription within the inorganic domain (the sand), which results in the recursive logic of recollection—mechanical reproduction invites knowledge into a dance with artificially reconstructed memory.[7] Socrates, noting how knowledge springs forth from the inscribed calculation concludes by noting:

> Meno, can you see where our friend here has got to on his journey towards recollection? At first, he didn't *know* which line would produce the figure with an area of 8 square feet—just as he doesn't yet know the answer now either; but he still *thought* he knew the answer then, and he was answering confidently, as if he had knowledge. He didn't think he was stuck before, but now he appreciates that he is stuck and he also doesn't think he knows what in fact he doesn't know (Waterfield, 2005: 84a-84b, 120).

The Socratic elenchus here asserts that the correct process of questioning (by oneself or an external agent) elicits the recollection of relevant truths and is markedly dialectical—that is, despite the fact that it is Socrates who proposes the definitions or ideas for discourse, he does not examine them or grant them truth-value until he gains a measure of agreement from his interlocutor (in this case the slave-boy and Meno). In the *Meno*, this process is synthesized by way of the inscribed formula, finding its nexus in artefaction. The formulation of artefaction, as the offspring of a dialectical intellectual process, is normatively positive[8]—occupying the space of calculation-cum-inscription, that provides for recollection of that which was dormant: knowledge, which becomes prosthetic. The Hegelian philosopher of technology Ernst Kapp (1808-1896) called this process 'organ-projection', German anthropologist Paul Alsberg (1883-1965) termed it 'body-liberation', mathematician Alfred J. Lotka (1880-1949) deemed it 'exosomatic evolution',[9] and André Leroi-Gourhan (1911-1986) called it 'exteriorization'. Despite the various verbiage, the central principle remains the same: the human and its function(s) becomes delaminated from any particularized specializations and adaptations, such that mankind configures an existence *for itself* by way of inventing technologies. In doing so, mankind externalizes its bodily functions, automating its means of survival by way of artificializing its environment so as to supplement its biotic deficiency.

For the sake of this paper, we will focus on the recursive logic at play here, and thus limit ourselves to two strands of thought: dialectical and non-dialectical. The first camp ensnares a collective of dialectically-minded philosophers, who—reaffirming the humanist Hegelian project of the *Dasein* of *Geist* as progressing via an asymptotic telos—imply that technological evolution is necessarily carved around lines of succession, wherein 'technological progression' finds itself always countered by the intervention of negativity. In addition to Kapp, Alsberg, Lotka, and Leroi-Gourhan this genealogy includes Alfred Espinas (1844-1922), Georges Canguilhem (1904-1995), Arnold Gehlen (1904-1976), Heinrich Popitz (1925-2002), Raymond Ruyer (1902-1987), Bernard Stiegler (1952-2020), and Marc Azéma (b. 1967),[10] many of whom are often regarded as philosophers of 'organology'. Before more closely examining the Hegelian core of this project, let us clarify what, exactly, being a thinker of organology entails, as it invokes a particular conception of reflective thought that recalls a central pillar of the first-order cybernetics of Wiener, McCulloch, and Shannon: positive feedback within a closed system. This is an important schema to keep in play as we review the Hegelian notion of self-externalization.

Organology

'Organology', as a philosophical system, concerns itself with how recursive forms occur in nature and, thus, has an inherent ecological penchant. It invokes an epistemological and differential rendering of synthetic division—that which is inorganic is differentiated from that which is organic, such that one can direct the reflective judgment towards the object of thought, deracinating consciousness from the object of consciousness. Organology is a synthetic thought 'that not only integrates but also searches for a new epistemology that creates a new loop' (Hui, 2019: 25). As evidenced by the 1947 paper 'Machine and Organism', Canguilhem was the first thinker to use the term 'organology';[11] in refusing the mechanist purview, Canguilhem purposed this term in order to consider the relation between organism and machine within a dialectical purview while reverting the Cartesian epistemology (of mechanizing life). Where, according to Descartes, the body and its movements are governed by mechanical rules, for Canguilhem they are governed by something

far more fundamental and primary—an exigent vitalism that is always translated by way of represented. Canguilhem rejected the parallelism between organisms and machines—organisms are not *necessarily adaptive* and, thus, can display pathological behaviors; machines (specifically, Canguilhem seems to have had the automata of first-order cybernetics in mind) on the other hand, are guided by a telos—fixed pre-programmed goals. Where organisms are able to self-organize and self-repair, machines cannot repurpose their goals, programs, or directives; Canguilhem remarks that '[i]t can easily be said that there is more purpose in the machine than in the organism, because the purpose of the machine is rigid, univocal, univalent. A machine cannot replace another machine' (2008: 89). Although this was not necessarily the case, as Norbert Wiener's work on homeostasis and adaptive response was formulated around the concepts of emergency, error, and shock (modelled around Walter Bradford Cannon's work on fight-or-flight response), [12] for Canguilhem—and the philosophy of organology thereafter—science and technology are understood to be circular, with the body and its nomological laws reinforcing something more primary: life.[13] This gives a clue as to why, exactly, Canguilhem's 'organology', and, in turn, the project of organology writ large is *dialectical*. Rather than constituting a supersensible world, the nomological laws of nature are understood as making explicit something that is implicit already in ordinary empirical descriptions of how things are.

Canguilhem's rethinking does not reduce the machine as the equivalent of the human but, instead, conceives of the human-machine as an organic whole, set into dialectical motion. Canguilhem's conception was inspired by many other thinkers, including Kurt Goldstein and his theory of holism, the exteriorization theory of Leroi-Gourhan,[14] and Kapp's *organprojektion*.[15] Organology finds its most *markedly* Hegelian articulation with Kapp, who coined the phrase 'philosophy of technology' in 1877. Kapp was a Hegelian philosopher true and true, whose work sought to demonstrate technics as the synthesized projection of organs, tools understood as biophysical hardware, with the ineluctable human canalizing itself by way of its technology. For Kapp such tools mechanically reconstruct organic form, serving as indices of morphological residue. As a Hegelian, Kapp's image of thought finds the human (and the human project) reasserting its primacy, entailed in dialectical becoming. Kapp's understanding of the tool illustrates the Hegelian core of media-as-

externalization, wherefore the universal and singular forms are entangled in totality, each containing the determination of the other within it and, thus, the two are wrapped into absolutely one totality, their oneness the diremption of itself in the free reflective shine of this duality.[16] Having now reviewed organology, let us now implore this Hegelian core.

Spirit, the Rational Object, and Definite Conception

In Hegel's *Phenomenology of Spirit* (1807), the notion 'alienation' is moored to two German terms that Hegel utilizes: '*Entfremdung*' and '*Entäusserung*'. Although both have often been translated as 'alienation', in parsing this heteronomy with a sharpened conceptual scalpel at hand we ought to note that '*Entfremdung*' more closely refers to *estrangement* as the process or state whereby consciousness is separated from one or more of the aspects required for consciousness to fully understand itself. '*Entäusserung*', on the other hand, is the process where consciousness externalizes itself in an object-ified form and, by way of the object, develops a more adequate understanding of itself. The former is linked to *alienation* and the latter *artefaction*, as (self)-*externalization* is the way consciousness learns that it is not purely a subject and has an ontological structure that not only incorporates a relation to objectivity but *depends on this relation*. In turn, consciousness is purposed and re-purposed, deracinated from the subject as it is distributed among a community in the form of concrete content—instrumentalized vide the form of work and the objects of labor. Thinking, the profoundest aspect of Spirit with its highest activity being to comprehend itself, unspools by way of its operations, which direct themselves towards determinate activity, the aims of finitude. Thus, we see how cognitive activity is directed not towards *interiority* but a determinate actuality. For Hegel, the nature of Spirit must particularize itself to become true and this is achieved by way of movement towards externalization: "consciousness is essentially this process—not a remaining static in the immediate natural state but a passage through a process in which what is eternal or true, as its essence, becomes its object or purpose" (Hegel, 1990: 21).

For Hegel, the activity of object-ification transfers and converts *empty objectivity* into a manifestation of being in-and-for itself, i.e., self-determination. For "[a]s soon as the

universal is externalised, it takes on a particular character. In isolation, the inward dimension of the Idea would remain a lifeless abstraction, and it is only by means of activity that it acquires real existence" (Hegel, 1975: 79). Spirit abandons its original condition and discovers itself through what it performs, translating inner essence into reality by way of externalizing the universal concept and, thus, attaining a 'real' existence. For Hegel customs, laws, institutions, and symbols of ancient nations were vessels of speculative ideas and products of Spirit but the true fruit of Spirit never comes first; the speculative Idea is externalized, it is always the manifestation point of rationality upon worldly existence, where the potentiality in consciousness, volition, and action finds itself inorganically excised through its determinate object. Spirit, for Hegel, is not abstract, because "it is consciousness, but it is also the object of consciousness—for it is in the nature of the spirit to have itself as its object. The spirit, then, is capable of thought, and its thought is that of a being which itself exists, and which thinks that it exists and how it exists" (Hegel, 1990: 45)

Ray Brassier, in a recent conference chaired by Paul B. Preciado titled "The Parliament of Bodies: *Communism will be the collective management of alienation*" asks whether this heteronomy between '*Entfremdung*' and '*Entaüsserung*' implies synonymy? Spirit's self-externalization—that is, collective self-consciousness' self-externalization—is undoubtedly *constitutive*, but there is a marked difference between *how* Spirit realizes its freedom and *those ways by which it becomes bound or subjected to a foreign agency or power*, which is only, itself, an alienated or estranged form. That is, following Brassier's account, all estrangement is externalization but not all externalization is estrangement. Drawing from Adorno's reading of Hegel, Brassier proffers that this account evidences the dialectical interplay between Spirit's independence and dependence, wherefore Spirit frees itself form its subjection to nature, achieving spiritual independence/autonomy, and in doing so moves towards culture as a kind of "second nature" to which it then becomes subjected. It becomes dependent on societal institutions, customs, and norms in a manner by which Spirit's freedom is significantly diminished. At once, naturalness or instinct is replicated within Spirit, manifesting within it in an estranged form while, institutions, customs, and norms begin to function *as if* they were nature. The anthropologist Arnold Gehlen would later similarly refer to reified second nature but by way of mankind's deficiency, using the term "ersatz organs" when describing technologies and

institutions alike, with both of them compensating for the unfinished or lacking human; nonetheless, in both accounts in furnishing institutions qua norms culture becomes man's "second nature."

Accordingly, for Hegel every self-consciousness denaturalization engenders an unconscious re-naturalization, repressing Spirit. First there is subjection to necessity and then emancipation by way of generating another form of subjection. As Ludwig Feuerbach, a key disciple of Hegel, remarks: "Man—this is the mystery of religion—projects his being into objectivity, and then again makes himself an object to this projected image of himself thus converted into a subject; he thinks of himself as an object to himself, but as the object of an object, of another being than himself" (Feuerbach [1841] 2008: 181).

Objectification thus yields the object to which the object-ifier is objecti-fied internally. This is the *processual movement* of alienation as double-objectification in Feuerbach and the young Marx.[17] A naturalized scenography divulges itself where humans are necessarily self-externalizing, i.e., producers by nature. The termination of subjection is not the reinstatement of interiority—externalization is not the externalization of a pre-existing originary substance or the index of a vital source but, rather, a constant process of amendment, with this process generated because of the *constituent non-identity of humans as self-transforming producers*. Given this picture of Spirit, we are encouraged to see self-externalization as resulting in either a state that is alienated or un-alienated depending on the circumstances in question. Stiegler, however, collapses all norms and exercises of freedom into alienation by way of mechanical compulsion, such that we cannot measure the discrepancy between realized and unrealized collective human freedom, for our metaphysical collective Spirit is always being outpouched by way of a processual unfolding.[18]

Recall how, in the *Science of Logic* ([1816] 2010), the universal and singular form totality, the concept passing into concrete existence which is, itself, free and is none other than the 'I' or pure self-consciousness. The 'I' is the pure concept itself, the concept that has come into determinate existence and finds itself instantiated into all manmade hardware.[19] In *Philosophy of Nature* ([1830] 1970), Hegel constructs concepts that define Being by way of a tripartite model—the mechanical, the chemical, and the organic—demonstrating that these are instantiated into our productive experience of

the world in equal part, with the living body sustaining this 'contradiction' (Hegel, 1970: 10).[20] For Kapp, Hegelian production as such is conceptually compounded into machine- or tool-construction and machine- or tool-use, with this 'contradiction' elaborated upon by way of technical objects (which exteriorize, or 'project' the organs of the body). Via Absolute Spirit, the eternal idea in and of itself keeps itself concentrated and reproduced, continually regenerating itself and enjoying its eternal status.[21] By demonstrating an inner affinity between the constructed tool and the human organ, Kapp's notion of *organprojektion* ('organ projection') facilitates a constructive affinity that is drive-based, as artefactual technesis results in the human being's made partial, or divided, such that the artefact serves as a means of reproduction. While contemporary Hegelians such as Robert Brandom take an interest in how language's reproduction is equipollent to mankind's sapience, Kapp designates technical objects as similarly primordial and biological—for Kapp, the human impulse to manufacture tools and machines is steeped in the well of cognitive activity from which language is drawn, with tool-construction similarly understood as reproductive activity fettered to reason and knowledge-production. With the organ-cum-tool or -machine now partially separable from the entirety of Being, mankind's Being is *defined and derived* through the attributes, usage, and complexity of practicability.

Kapp's cyclic and augmentive-physiognomic description of artefaction reveals his Hegelian plexus, with the ontological paradox of dialectical historicity as premised on an open Whole that is irremediably ruptured by its own absolute negativity. However, as the aforementioned description makes clear, his understanding of technical objects is normatively positive, with tools archiving consciousness. Another dialectical philosopher of organology, Raymond Ruyer, reserves consciousness as a kind of 'absolute' form with non-localizable zones of indetermination. According to Ruyer, animal species produce phenotypically externalized technologies—'spiders weave webs, beavers build dams, birds construct nests' (Smith, 2017: 121). In contrast to animals, humans engage in the quasi-finalist endeavor of fabricating technical artefacts. Here, Ruyer recollects Kapp's morphologically-directed and evolutionary understanding of artefaction—the 'hammer externalizes the forearm and fist in wood and iron; clothing externalizes the skin; a baby's bottle externalizes the mother's breast; a kitchen stove externalizes the stomach; and so on' (Smith,

2017: 121). Directly citing Leroi-Gourhan's work while simultaneously calling to mind Kapp, Ruyer also notes that our 'externalized organs' become detachable, removable and disparate from our body—therefore, our 'bodily organs' are, themselves, uniquely technical artefacts.

With Canguilhem, Kapp, and Ruyer, Being has its foundation in the question of eternal metahistorical identification, which begins with the Absolute Idealism of Hegel's teleological arrow but is further continued by the account of post-mechanist natural science, where Being is explicitly related to self-hood and presupposes 'a whole of which subjects and objects are parts' (Hölderlin, 1988: 124-126). Given form by the reflective judgment, which imposes limit conditions upon cognition's freedom, Being materializes and internal emergence is extended through technologies. However, none of these aforementioned thinkers of organology were alive to speak of *digitally embedded and networked technologies*; Stiegler remains heir to organology, although he wields the throne as a pessimist of necessitarian alienation, collapsing technesis writ large.

Alienated and unalienated states do have a place of distinction for Hegel, however. Hegel's insistence on phenomenological immanence amounts to the claim that we cannot arbitrarily create a criterion of unalienated Spirit based on what our current historical conception of what freedom is and, in turn, rules out any appeal or reference to an unalienated originary state. *Thus, there is no such originary unalienated state, it is the stuff of mythology*. This is the critical constraint of historical immanence, such that any differential criterion must be internal and immanent to the shape of self-consciousness that is held under consideration. The problem is that the historical sequence is not empirically given, so we do not have access to it by way of our perceptual history. For Hegel, try as we will, we cannot get at alienation by threading historical facts together into a progressing narrative that unfolds from past to present. Deliberately and self-consciously constructing the retrospective preconditions for our current self-conception as free or unalienated is a matter of retrogressing to a *previous* unfreedom or alienation (in order to then discern our current measure of freedom or unalienation). As Brassier says, "it entails that we are never in complete possession of the resources through which we confidently distinguish between alienating and non-alienating automatisms among contemporary

customs, institutions, or norms" (2020). The processual model of alienation reifies the moments in what is, for Hegel, an *indivisible movement*, where compulsion and freedom coincide. Estrangement cannot be the return of repression within spirit so long as this return is understood as the reiteration of a proceeding state and we are never in complete possession of the resources through which we could confidently distinguish between normatively positive and negative automatisms (as well as the technologies underpinning them). To acquire such resources we must retrospectively reconstruct the indivisible movement between what coincides, and this is but an impossible task. Estrangement and de-estrangement, compulsion and freedom, coincide for Hegel such that estrangement is not a repetition of compulsion within the attempt to undo compulsion so long as this repetition is understood as the reiteration of an initial or preceding state. Alienation proper, in both Marx and Hegel, is externalization as de-estrangement-cum-estrangement; the prospect of an unalienated state emerges by retrospection and, as a consequence, there can be no narrative about overcoming the need to overcome so long as self-externalization is compelled by the need to dominate external nature. Alienation will always generate a surplus of estrangement, a series of compulsive automatisms that prevent us from realizing our freedom.[22] As such, we are necessarily directed towards constructing our machines—it is how we concede to Spirit, convincing Spirit of rationality's vim. In order to create an incision to solve the two unique problems that emerge here, the problem of phenomenological immanence (with Hegel) vs. the problem of naturalized metaphysical lossage (with Stiegler) we will eventually take a more systems-theory oriented approach that emphasizes how homeostasis and autopoiesis figure into the introduction of novelty, where any system's equilibrium is directed by way of technical objects and their entanglements. First, however, let us more exactingly scrutinize Stiegler.

Stiegler's Fatalism and Digital Media Artefacts

Is Stiegler's program truly one of Prometheanism? If Prometheanism is the rejection of predetermined limits on action and self-transformation, then the parallel between rationalism and Prometheanism suggests that if action is constrained by thought and self-transformation is constrained by self-understanding, then the rejection on limits

on one entails the rejection of limiting the other (Brassier, 2014). That is, Prometheanism proposes that all reasons are 'artificial' and *rejects limits on artificialization*, enjoining the wholesale reengineering of intelligence to our techno-environmentally embedded ecology according to a more rational program of self-invention than Stiegler's prescription of quasi-theological limits to artificialization.

Kapp sparsely appears in Stiegler's pages as a direct source and Canguilhem even less so. Nonetheless, for Stiegler, as was the case for Kapp and Canguilhem, tools are imbricated in habitus. For Stiegler the relationship between tool and cognition is reflexive: '[t]he interior is constituted in exteriorization' (1998: 141), such that the tool (re)invents the human just as much as the human invents its tools. Stiegler's conception of Being recalls Hegel by way of its plasticity: Being here is progressive not only in the sense that information, as it is exteriorized beginning with early lithic technologies, accompanies hominid evolution but also in how media are related to neural development. Thus, Stiegler's engagement with externalization, like his predecessors, is preoccupied with registers of cognition. For Stiegler, like the flint tool, tools of writing are understood as epiphylogenetic vectors that advance corticalization; although stone tools were not crafted with the intention of storing memory, for Stiegler they inadvertently do so, inciting a series of learned motor actions (e.g., flexing the elbow in the act of using a hammer). Despite retrofitting Kapp and company's conception of media-as-externalization, however, Stiegler's sociological argument re: technics elicits an admixture of Derridean ontology with Husserlian phenomenology, where the externalization of technology imbricates mind and intention through successive feedback loops. Consider, for instance, how for Stiegler the true advent of externalized memory ('mnemotechnics') finds its pinnacle with the invention of writing and demarcation; according to Stiegler, writing stabilizes language (vis-à-vis time-consciousness) in both the brain and the discursive world.[23] Unlike writing, however, Stiegler regards those digital technologies that store memory, such as smart-phones and tablets, as software agents that deprive the user's freedom, making choices for the user in advance (Stiegler & Rouvroy, 2016). For Stiegler, with analog media after writing, but especially with digital media, we see not only the exteriorization of intention, mind, and memory *but also its loss*—instead of expanding the capacities of the human mind and brain, a loss occurs, outsourcing the mind without emancipating the human agent. If we are to take Stiegler at his word,

digital artefaction's relationship with technē ought to be understood as normatively negative, as it results in the deprivation of human agency (what Stiegler terms 'noesis') and alienation:

> This exteriorization that constitutes the principle of 'liberation' is always also an 'alienation': it leads to an offsetting of neganthropic possibilities to exosomatized organs that amounts to a kind of dependence, which is the basis of proletarianization as the loss of knowledge (of how to live, work, and conceptualize), that is, as entropy. This is nothing new (Stiegler, 2019: 50).

In a recently translated book, *The Age of Disruption* (2019), Stiegler makes it his mission to:

> …show, by combining Foucault's analysis with that of Sloterdijk, that what the latter describes as a process of disinhibition is made possible by the tensions and contradictions that occur over the course of the successive doubly epokhal redoublings that unfold from the late Middle Ages to the Renaissance, the classical age, the first industrial revolution, the advent of Taylorism (which is also the advent of consumerism, the culture industry, and marketing), and, finally digital technology—agent of the contemporary disruption (ibid., 111).

The Age of Disruption is only the most recent articulation of this project, but since it is the most recently translated into English,[24] it includes the most novel references to digital technologies, including GPS vehicle tracking systems and smart watches. While references to actual technologies are sparse, it seems that Stiegler has no laudatory words for recent developments such as fitness wearables and location tracking apps that harvest data and metadata, or which engage in social media sharing and life-logging infrastructure. For Stiegler, these technologies are far from the positive self-archivization or self-curation of labor that those such as Gordon Bell and Jim Gemmell identify with becoming 'the librarian archivist, cartographer, and curator of your life' (2009: 5); for Stiegler such embedded wearables further disembody one's autonomy by way of pushing us into an objectified mass, each of us becoming an unwitting member of the cognitariat.[25]

Mark B.N. Hansen's critique of Stiegler takes his normatively negative positioning of phenomenology as its object. For Hansen, Stiegler's phenomenological system is tunnel-visioned; Hansen's project takes issue with this picture of consciousness that undermines what also makes networks and microtemporal digital devices useful—their possibility of shaping the future by way of honing in on the operational present (in a way that we, deprived of digital technologies, are restrained from accessing). Unlike Stiegler, Hansen sees digital media as also engaged in the channeling of agency, and thus understands the '*causal efficacy*' of digital media as normatively positive (2015: 197). For Hansen, twenty-first century media in particular can enhance our cognitive, perceptual, and sensory agency precisely because they put us into functional cooperation with other cognitive, perceptual, and sensory agents that not only follow protocols of their own, but that, most crucially, operate environmentally—'independently of and autonomously from our directly experienced, conscious agency' (ibid., 183).

Hansen's critique primarily cites Deleuze's machine ontology and Whitehead's process philosophical system to account for that which Stiegler's occludes. From Deleuze, Hansen recuperates how 'media might impact experience without being channeled through delimited, higher-order processes', thus understanding media as ends in themselves (36). From Whitehead, Hansen reconceives of how perceptions can be understood from within the material universe where causality reigns, moving beyond a strictly perception-centered account to one where perceptions are, themselves, caused by the very same kind of shift that causes all events in the universe's becoming (48). Moving through causal processes in cyclic fashion, Hansen, too, is a thinker of dialectical organology, using Deleuze and Whitehead's process philosophy to understand the non-perceptual world through the aperture of perception.[26]

Another feature of Hansen's project is his conception of 'feed-forward' systems, which presents propensity as causally directed by future efficacy, such that continuous data-gathering, microcomputational processing and predictive analytics make a new episteme possible. According to Hansen, our contemporary conception of *technē* must be understood as an 'enveloping of virtualities offered to the body, which constitutes the fundamental anchor point for present and future technological

evolutions, and which induces an automatized and fluid relation to the milieu' (Hansen in Grusin, 2010: 117-118). Consequently, Hansen's resolutely speculative ontologising of predictive processing is predicated on an ecological functor of equipossibility and the independence of outcomes.

According to Hansen, Stiegler's conception of technicity does not properly apply to today's enactive field of predictive calculation. That is, Stiegler's model of time-consciousness and anticipation (what Stiegler calls 'protension') operates in relation to a static source of inert possibilities. Hansen remarks that predictive probabilities, on the other hand, do not project past data into the future but *generatively integrate present data*:

> [w]hatever else it betokens, twenty-first-century media centrally involve a massive expansion in, as well as a fundamental differentiation—a 'heterogenesis'—of, the interface between human being and sensory environment. Consciousness's Being [...] becomes, in and through the operationality of twenty-first-century media, a functional [...] processual, relationship. With this functionalisation, moreover, the relationship between aboutness and being, between data as access to sensibility and data as sensibility, undergoes a certain reconceptualisation through its anchoring in temporalisation: aboutness is linked to being in an incessant oscillation, where each act of access onto sensibility creates a new unit of sensibility that itself calls forth a new act of access that creates a new unit of sensibility' (Hansen, 2015: 17).

Hansen is, effectively, interested in the 'becoming' of homeostatic systems that self-regulate, a becoming that Stiegler reduces to an ellipsis of lossage, a telos of asymptotic reduction whereby creativity, potential, and freedom find themselves overturned to disruption and anomie (Stiegler: 2019). In addition to Hansen's critique, however, and perhaps more detrimentally—particularly when we consider how Stiegler conflates the conditions for genesis of language with the conditions of its reproduction when he writes about linguistic systems—we can remark that Stiegler *negotiates metaphysics from within*. There is no distinction in terms of complexity between the analog and the digital,[27] just an arbitrary line between that which is fundamentally tethered to organic existence and preternatural existence, which is

negatively determined. That is, Stiegler produces a quasi-materialist ontology that positively addresses the Hegelian Objective Spirit as the inscription of object-ified knowledge, according to which 'objectified knowledge is the consequence of the epiphylogenetic formation that arose in life with the practical activity of human beings' (Stiegler, 2020: 179). Yet Stiegler's explanatory ontologization of grammatization is akin to a half-formed functionalism that engages solely on the level of empirical content—it characterizes a system as functional in nature by treating its function in terms of stimulus-response dispositions. In short, Stiegler does not differentiate conceptual activity from non-conceptual activity. For the early Hegelian theorists of externalization/projection, the *Dasein* of *Geist* supervened upon ontogenesis but, for Stiegler, there is no differential identity of acquisition.

Simondon and Constructivist Cybernetics: On Second-Order Systems

How, then, can we extract a philosophy of differential media without reducing the objects of mediation to (externalized) appearances? Hansen is, indeed, correct to point out that what Stiegler elides is a process-philosophical understanding of causality. Instead of Deleuze or Whitehead, however, I propose a return to Simondon—specifically, that which Stiegler misses in Simondon. Stiegler is, as I seek to demonstrate, a crude reader of Simondon and in some sense a traitor to Simondon. First of all, Simondon is utterly opposed to Heidegger,[28] as Simondon actively dismisses the study of technical objects in terms of the relations that can be established with them.[29] Simondon's project is marked by a sociological stripe: to reclaim technical operations from the teeth of (Capitalist) work and prod forth specialization and a place for a philosophy of technics, which is markedly scientific. This means separating technical activity and knowledge from the doctrine of work, Capital, and the criterion of productivity by encouraging a relationship between man and technical objects where one is not only the owner of their machines and means of productions but imbricated in their maintenance, adjustment, engineering, knowledge, and further invention.

Simondon offers a unique stripe of process philosophy of the 'transindividual', which Stiegler refers to in name only but does not make conceptually central to his system. Deleuze's machine ontology, at least as it treats 'actualization' (the co-determination between beings and technical artefacts), is tethered to Simondon so rather than jumping to Deleuze in order to analyze today's digital protocols, my study—which agrees with Hansen that process philosophy has immense instrumental value to understand 'feedforward systems'—turns to Simondon. First of all, what distinguishes Simondon from the previous dialectical thinkers of organology is that Simondon is a thinker of genesis above all else. This is why he will serve as a valuable resource when we consider the roots of deep learning's algorithmic infrastructure given case studies such as AlphaGo Zero, which has been admired by philosophers and technicians alike due to how it generates inventive winning moves that even master players such as Lee Sedol and Ke Jie could not predict (e.g., the infamous 'move 37').

Furthermore, Simondon's philosophical program is non-dialectical. This also sets him aside from the aforementioned Hegelian genealogy. For Simondon, genesis' role is to deal with something that dialectics elides, as Simondon's conception of individuation does not correspond to the appearance of the negative. Rather, Simondon considers the role of genesis as something immanent to conceptual negativity; Simondon, as a thinker of the existence of potentials, is primarily preoccupied with the cause of incompatibility and the non-stability of pre-individual genesis—that which precedes the genesis of an object. Given his penchant for complex systems, we will also make the case for Simondon as a thinker of second-order cybernetics (the conceptual predecessor to deep learning's logic of predictive inference). Alongside genesis, Simondon is concerned with *transductive relations*: how subjects and objects engage in mutual structuration such that identity is metastable (much like second order cybernetics and W. Ross Ashby's conception of allostatic behavior). Unlike Hegel, for Simondon the negative appears initially as an *ontogenetic incompatibility*, but, after examination, reveals itself to, in actuality, merely illuminate a wellspring of potentials. Thus, Simondon's notion of the 'negative' is not a substantial or regulative negative—it is not a stage or phase. Unlike Hegel, Kapp, Leroi-Gourhan, or Stiegler, the process of individuation for Simondon is *not a*

synthesis or return to unity but a phase-shift of Being based on a pre-individual center of potentialized incompatibility.

Simondon's description of communication as such is critical to consider in formulating a rigorous philosophy of becoming that applies to machines and their systems of equilibrium, which I argue is a highly pertinent concept when thinking of predictive patterning in deep learning, a development born out of second order cybernetics' critique of first-order cybernetics. Simondon's *On the Mode of Existence of Technical Objects* (2017) is composed of three sections. Part I, entitled Genesis and Evolution of Technical Objects, is devoted to the study of the machine itself and closely considers the terms of what computer scientist John Hart[30] terms 'intrinsic machine reality'—that is, Simondon parses the principles of the nature of the technical object while supplementing this study with corresponding examples. Part II, Man and the Technical Object, launches a critique of mechanology and first-order cybernetics, particularly Norbert Wiener's mechanist paradigm. Simondon's conception of technical objects opposes the conception of automata according to a human resemblance-model or the conflation of natural and technical objects, preferring, instead, an analysis by way of functional organization. In the final section, Part III, Genesis of Technicality, Simondon most lucidly articulates his normative program concerning the convergence between technics, the machine, and philosophy.

Why is Simondon a thinker of environmental synergies? In order to make the normative value of 'technics' clear—for Simondon, 'technics', as a philosophical term, invokes normativity in a way that 'technology' does not—Simondon recalls a curious incident. Simondon notes that 'about ten years ago' a group of science university students attempted a small profanation that illuminates the normative value of technics outside of the practical consequences they generally appear to entail. The science students disrupted the clock atop the Paris Observatory, causing an uproar (2017: 229). Simondon highlights this as an example of the inherence of technicity's values surpassing utility, critiquing the Heideggerian conception of technics as separate utensils understood solely through their relational status as ontic objects (i.e., by way of their use-value), shining a light on the *necessarily networked* nature of technics—such is the reticulated structuration, which can change in

intensity but never disappears (even though its 'readiness-to-hand' is modulated by way of its breaking).[31] The reticulated nature of technics is thus well illustrated by the image of the Paris Observatory clock domineering over the perturbed Parisians.[32]

According to Simondon, 'technics' considers the coordinated and mutually organized relation at the level of machines, man, and culture. For Simondon, 'the true nature of man is not to be a tool bearer—and thus a competitor of the machine, but man's nature is that of the inventor of technical and living objects capable of resolving problems of compatibility between machines within an ensemble' (2017: xvi). In rendering machines compatible with a particular function, man opens up the mutually contingent flow of information, a signal of *transindividual* exchange.[33] Man's assiduous invention and reinvention also invites technicity to unmask the pretensions of rationality, with Simondon's concept of invention shepherding the long-term progressive undertaking of a program of self-betterment and self-improvement rather than the blind effect of contingent causes.

 In Genesis and Evolution of Technical Objects, Simondon pursues a review of various technical objects and how the technical object, in itself, is characterized by sundry functional processes and modalities of genesis. Simondon separates the genesis of the technical object, by which it becomes a proper object of study, into a tripartite and non-dialectical cast: *the element*, *the individual*, and *the ensemble* (20). Much of Simondon's research is devoted to the erudition of particular machines, their evolutional lineage(s), and their functional assemblies—Simondon undergoes this pursuit with impressive rigor. From Coolidge and Crookes tubes to thermo-dynamic machines, anode-cathode synergies, semi-conductors, and vacuum valves, Simondon carves a *pure schema of functioning*, examining technical objects and their conductance by way of and through the phenomena from which their fecundity foments. Of particular interest to Simondon is *concretization*, the process by which any technical object is posited within an intermediate place between the natural object and its scientific representation. This process is separate from invention, the latter dealing with our genealogical heritage and natural kinds. Rather than the shift from idea to physical artefact, *concretization* deals with internal self-coherence (cycles of refinement), the 'way technical objects shift their internal composition as they iterate from one version or instance of a schema to the next' (Rieder, 2020: 61-62).

According to Simondon's system, the *primitive technical object* is distinguished from the constitution of a natural system—the primitive technical object is not a natural/physical system but the 'physical translation of an intellectual system' and, thus, a bundle of applications (Simondon, 2017: 49). Opposed to the *primitive technical object* is *the concrete technical object*, which produces a mapping of causes and effects by way of internal coherence (homeostasis), a closure of functional resolve that designates the technical object's evolution and processes of human intervention. Simondon provides the example of an artificial plant/flower grown in a greenhouse, which yields petals—'a double flower'—and is unable to bear fruit due to processes of human grafting (49). By way of *artificialization*, the interventive rendering of a natural object into a complex system of thermal and hydraulic (i.e., autopoietic) regulations via machinic coherence, we see how biological capacities and their functions are outpouched to a mechanic framing system and, simultaneously, are specialized in cyclic fashion.

 In Man and the Technical Object, Simondon's criticism of Wiener's project brings forth considerations similar to that of cybernetic constructivism, endo-modelling, and action-oriented neuroeconomic patterning—the tenets of second order cybernetics which we will further elaborate on soon. Written in the 1950s, this section finds Simondon critiquing Wiener's 1950 publication, *The Human Use of Human Beings*. Conceptualizing information as an entity distinct from the substrate(s) carrying it and likening self-regulating technical objects to living beings, Wiener here proclaims that:

> '[i]f the feedback system is itself controlled—if, in other words, its own entropic tendencies are checked by still other controlling mechanisms—and kept within limits sufficiently stringent, this [disastrous instability] will not occur, and the existence of the feedback will increase the stability of performance of the gun. In other words, the performance will become less dependent on the frictional load; or what is the same thing, on the drag created by the stiffness of the grease. Something very similar to this occurs in human action' (1954: 25).

According to Wiener, man (and the animal) have a kinaesthetic sense that, like the machine, is subject to varied external environmental effects related to informational

exchange by way of negative feedback. In turn, contingency acquires meaning by way of reference to recursion. This is precisely why Wiener compliments any mention of homeostatic processes with internal regulation, finding a parallel in the nervous system and computing machines wherefore computing machines and human/animal nervous systems are conceived of by way of reference to physiological processes of detection, an 'all-or-none' principle of measuring transmitted intensity (Wiener, 1965: 120). Following the prototypic probabilistic laws of internal regulation and Leibnizian universalism, Wiener's cybernetics conceives of information by way of measurement as a degree of organization. For Simondon, however, technical objects must be studied in their evolution in order for one to discern the process of concretization. Simondon is not satisfied with Wiener's conception of individuation by way of circumscribing probabilistic events. While Simondon's conception of individuation is equipollent to an understanding of information concerned with that which precedes differentiation and facilitates an operation in a system, Simondon also harbors an ulterior concern: the intra-individual psychical problematic of perception and affectivity, which leads to the collective level of the *transindividual.*

Since Simondon's target is first-order cybernetics, with reference to Wiener in particular, it makes a great deal of sense that criticisms similar to those launched by Simondon in the late 1950s would be prodded forth by those second-order cyberneticists (of the 1960s and 70s) who endorsed the *endo-model.* The *endo-model* provides for an understanding of *models within systems*, as opposed to *exo-models*, or *models of systems* (i.e., models that we, as observers, construct of systems). The *endo-model* is a stable and simulated internal control system used to model anticipatory control dynamics between mode, system, and environment. This *endo-model* also introduces environmentally coupled relations of entailment, force, and influence, wherefore the phenomena of circular causality, self-reference, and self-production dovetail via autopoiesis. Unlike Wiener's interest in regulation by way of negative feedback, autopoietic systems—as delineated by Francisco Varela, Humberto Maturana, and Ricardo B. Uribe's work in biology and supplemented by Milan Zeleny's work on the economy of self-sustainable systems—deal with the structural knowledge that makes a system capable of producing/reproducing its unique self-organization. Unlike Wiener's cybernetics, second-order cybernetics' autopoiesis necessitates a *physical boundary* that separates the system from its surroundings; in

Simondon, we see a similar treatment of technical objects and their associated milieu(s), i.e., a similar segregation of subjects from objects. As a theory of self-reference, autopoiesis takes those processes generated through a closed organization of production and designates that this same organization is regenerated through the interactions within a system's own products (or components).

Ernst von Glasersfeld, Heinz von Foerster, and Maturana's elaboration of machines as autopoietic or self-creating systems articulates Simondon's concern in distinguishing how transindividual systems can be considered as distinct from a transmission model where knowledge is directly thought of and conceived as being a representation of an external objective or mind-independent reality (as in the case of Wiener). According to Glasersfeld and Foerster's *functional constructivism* there is a systematic interface from which all of our knowledge about the world springs forth. We do not have access to the description of any environment but, instead, *features*—particular patterns with which we construct possible orderings of functional relationships (systems of categories, feature spaces, objects, states/state transitions, etc.). That is, we do not empirically recognize the given objects of our environment but are involved in constructing them by way of the informational regularities that becomes systemized, presented as they are at the interface of our cognitive system (Foerster & Glasersfeld, 1999). Glasersfeld's emphasis on observationally-constructed consensual domains finds its compliment in Maturana's notion of *structural coupling(s)* between system and environment, where consensual domains of interaction and communication are ecologically ordered between objects, events, and classes (Maturana & Varela, 1980). Moving from a reflective judgment and the moment of the 'I' to the 'not-I', communication is no longer about registration of information or its transmission, but instead a circular coupling between the 'I' and its environment in which each reentering (homeostasis) is indicated by the integration of reflection. For Simondon, this means a structural coupling between subject and totality and technical objects facilitate such transindividuation.

According to the research program of second-order cybernetics, there is reflexive acknowledgement between structure and behavior regardless of whatever *a priori* predications observers adopt. For such second-order cyberneticians it is critical to recognize that although there *are* such *a prioris*, observers become reflectively aware

of them vis-à-vis the epistemological, evolutionary, and ontogenetic development of systems (which observe and 'converse' with one another). This turn is often captured by the umbrella term 'radical constructivism', which endorses Jean Piaget's conception of knowledge as an *adaptive function*, echoing Simondon's appraisal of Wiener's cybernetic program for being mistakenly founded upon the 'intention of command and communication in the living being and the machine' while eliding detailed considerations as to 'how one can put individuals representing homeostatic functions at the heads of [organizational] groups' (Simondon, 2017: 160). Glasersfeld, Foerster, Valera, and Maturana take up similar concerns regarding the conception of knowledge and its *adaptive function*, wherein 'cognitive efforts have the purpose of helping us cope in the world of experience, rather than the traditional goal of furnishing an 'objective' representation of a world as it might 'exist' apart from us and our experience' (von Glasersfeld, 1991).

Despite the founding fathers of cybernetics such as Wiener, McCulloch, Bateson, and co. emphasized autonomy and self-organization vis-a-vis the self-organization and subjectivity of modelling, they were not all first-order reductionists. Ashby's constructivist turn is particularly important for the move away from first-order cybernetics—where a system is understood as passive and objectively given, such that it can be manipulated—into second-order-cybernetics, where the system is seen as cast in engagement with the observer. According to Ashby's 'constructivism', the observer, too, is a cybernetic dictum. In Ashby's framework, there are two critical principles that have become most important for homeostatic self-regulating systems:

1) *Homeostasis of Internal Essential Variables* (*Principle of Ultrastability*); according to this principle variables move beyond specific viability limits and, as a consequence, are part of adaptive processes that are triggered by and re-parameterize a system until it reaches a new equilibrium, at which point homeostasis is restored. In physiology, one can think of such essential variables as corresponding to blood pressure, heart rate, blood sugar levels. Such systems embody two levels of feedback at least: i) *a first-order feedback* that homeostatically regulates essential variables, like a thermostat, and *a second-order feedback* that allostatically reorganizes a

system's input–output relations when first-order feedback fails (Ashby, 1952).

2) *Law of Requisite Variety*; a successful control system must be capable of entering at least as many states as the system being controlled (i.e., 'only variety in R can force down the variety due to D' [Ashby, 1956: 206-207]).

Ashby's constructivist description provides a bridge between first- and second-order cybernetics, providing a paradigm highly useful for those contemporary models of neuro-inferential 'perceptual control theory' and 'inference to the best prediction' in Bayesian modeling.[34] Ashby's principles imply a minimum level of complexity for a successful controller (or, to recall Simondon, an agent of 'individuation'), which is determined by the causal complexity of the environmental states that constitute potential perturbations to a system's essential variables.

For Simondon, such 'error-correction' is inherent to how we deal with technical objects as inherently machinic, for they necessarily wield with equal force *a rapport to man* and *systems-relational characteristics* (i.e., *analogical structure* and *analogical human dynamism*). These two internal characteristics of the technical object simply cannot be understood if the technical object is conflated with the tool, 'which then makes it lose its individuality and therefore its own value; as Piaget has remarkably shown based on archaeological and ethnographic considerations, the tool is deprived of its own individuality because it is grafted onto another individualized organism's body part and because its function is to extend, reinforce, and protect but not replace the latter' (Simondon, 2020b, 417).[35] For Simondon, machines are not externalizations (of mind, memory, or intentionality) but endowed with differential relational situatedness in their own right. Simondon's critique of Wiener is at the level of cognition—including perception and action—and invention, with an interest in how systems maintain the homeostasis of essential variables and of internal organization.

More generally, Simondon's critique of cybernetics is rooted in his refusal to consider the machine as an isolated system. His concern is not with autonomous machines but with machines that are steeped in an exchange between machine and environment. Thus, Simondon marks a difference between machines that operate

with and by their own process and those machines that are able to modify their own process according to environmental variation. Such machines are distinguished from those like the thermo-siphon, which operates simply by means of registering or reacting to information (2017: 266). Simondon's interest is in systems that engage in a proper convergence of economic constraints and technical requirements, where the machine maintains its stable functioning (for as long as possible) while exchanging with its environment (i.e., reciprocal modification [2017: 21]). This is directly in contrast to how Wiener articulates man without reference to interiority by way of environmental homeostasis; Wiener conceives of the social system as 'an organization like the individual, that it is bound together by a system of communication' (1961: 24), where man and machine solely *exchange information* with their environment without being mutually constituted by way of adequation and relative positions of observational instability. Elsewhere, Simondon critiques not only Wiener but 'Shannon, Fischer [sic], Hartley' (2020b: 686)[36] and the given relationship of information as solely a relationship between an emitter and receiver. This centers our debate over whether information should be considered an explanatory tool—an epistemic heuristic that does not refer back to a basic constituent of nature—or fundamentally ontological. Thus, this position ultimately concerns whether information can be said to be ultimately fundamental when understanding the 'objective modal structure of the world', which reiterates our earlier concerns about the relation between structure and matter.

For Simondon, in order for culture to incorporate technical objects one has to discover an adequate intermediary between the majority and minority status of technical objects. With the former, social relations are brought into relation while, in the case of the latter, the object is conceived as a matter of utility. As a consequence, the 'secret and stable aspect of such a technics is thus not only a product of social conditions; it produces the structure of groups as much as this structure of the group conditions it. It is possible that every technics must to a certain extent contain a coefficient of intuition and instinct necessary for establishing the appropriate communication between man and the technical being' (Simondon, 2017: 109). Such a divergence between man and technical being corresponds to the discrepancy between any (perceptible) model of empirical predicates and its categorization, making the claim that such a chasm is not arbitrary. Rather, this fracture answers to

the meta-theoretic explanatory aims between objects' components/differential parts and the mind-dependence of sensory episodes: Simondon's conception of communication accounts for the inferential-causal dependency between the presence of physical objects with given qualities and a corresponding sensory experience, and the qualitative homogeneity attributed to such experiences. However, such a framework cannot explain the distinction between ostensible and veridical perception, and thus the possibility of error when making perceptual reports concerning the sensory determinations supervenes upon communication, which is always privy to error-corrections—Simondon's understanding of homeostasis, a becoming-equilibrium. Unlike tools taken in isolation, with machines and organisms, Being is thus conceived of as the structure of all structures, the absolutely primordial and comprehensive structure (Puntel, 2010: 439).[37]

For Simondon, the individual (or Being) is the reality of any constituting relation rather than occupying the interiority of a constituted term; thus 'the intrinsic, the interiority of the individual, would not exist without the ongoing relational operation that the ongoing individuation is' (2020a: 50). Unlike the aforementioned dialectical treatment of being, when it comes to the level of the individual Simondon understands Being as the value of a relation—at the level of individuation, the individual can be considered 'a being with an interiority relative to which an exteriority exists' (50). Thus, it is not the externalized media (the liberation of organs, mind, or memory) that defines Being, but the system that this media, digital or analog, *communicates across*.

Consider the model of crystallization which, for Simondon, allows him to establish a transcendental field for individuation without positing a substantialist division between different modes of existence, such as 'physical beings' (e.g., crystal) and living beings (e.g., plants). For Simondon, there is an ontological difference between physical and living beings: the former is characterized by carrying its associated milieu with it. For instance, the "crystal stops growing when you remove it from its aqueous solution" while the "plant may stop growing if you do not water it, but it carries a good deal of water with it, which allows for greater regulation of the relation between its inner and external milieus. It even puts water into circulation with its ecology' (Lamarre, 2019: 109). For Simondon, the transcendental movement of

evolution is not teleological or dialectical but deals with structure and reorganized material flows along transindividual relations, recombining aspects. Although some, such as Steven Shaviro, may draw the distinction that in Varela's 'autopoiesis, the emphasis is on a continuity that is created and preserved in and through continual change and interaction with the environment, whereas in individuation and [Whitehead's] concrescence, the emphasis is on the production of novelty, the entity's continual redefinition, or becoming' (Shaviro, 2009: 112), for Simondon the relational system maintains itself through dynamic interaction with its environment, re-creating the very processes that produce it. An entity not only reconstitutes itself by actualizing potentials that preexist in a metastable environment but negotiates this reconstitution with recursive homeostasis. This recursive logic is inseparable from the unspooling of novel systems, moored by homeostatic thresholds.

It is critical for Simondon that the technical object does not facilitate its own operation(s) but that there is an integration between the machine and the technical. Simondon often makes mention of 'the virtual', remarking that '[t]he living thing has the faculty to modify itself according to the virtual: this faculty is the sense of time, which the machine does not have because it does not live' (2017: 157). It is important to note that Simondon's conception of the virtual is distinct from Deleuze's. Simondon is not interested in the possibility of modification of process. He is, instead, describing a *real process* and this *real process is happening in actuality*, i.e., the process of individuation.[38] Consequently, Simondon is interested in the media object as a threshold of intensity and quality—here, Simondon is working against the hylomorphism of pure matter and pure form/the alliance of form and matter, which he deems a contradiction. For Simondon, the physical object is a bundle of differential relations, an organization of thresholds and of levels which are maintained and transposed via a myriad of variegated situations, with the object's properties cohering and undergoing variations as it moves from one state to another (2020a: 264-265).

To better understand this, we ought to situate Simondon within the history of philosophy. Simondon's philosophy begins with the Aristotelian classic model whereby we have *matter*, devoid of shape, quality, or determined characteristics, and we have *forms*, which are *a priori* and characterize matter by *giving them form* (while

being unique in kind as distinct causes). Simondon is actively working against this Aristotelian model of hylomorphism: for Simondon, there are no *a priori* forms that are imposed onto undetermined matter—matter is determined itself through the process of individuation. Simondon begins from matter rather than *a priori* forms, as forms emerge through a difference of matter by which matter is crossed, like a (quantum/differential) field, by a difference of potential. This is also analogous with our empirical observations—Simondon thus remarks that, if 'to perceive consists in increasing the information of the system formed by the subject and the field in which it is oriented, the conditions of perception are analogous to those of every stable structuration: a metastable state must precede perception' (2020a: 269). This 'objective field', which Simondon often makes reference to and describes as a primitive, neutral, and 'magical' stage, is the arena upon which man and mediation find themselves fundamentally structured through circuits of exchange qua being— that is, '[m]an finds himself linked to a universe experienced as a milieu' (2017: 177).[39]

For Simondon, the objectivation of mediation has a correlative in the subjectivation of mediation, which is object-ified and objectivized by way of the technical object that tethers man and the world to one another. The field of reference here, the 'magical stage', precedes mediation and, thus, precedes subjectivization or objectivization, neither fragmented nor universalized; it 'is only the simplest and most fundamental of structurations of the milieu of a living being: the birth of a network of privileged points of exchange between the being and the milieu' (2017: 177). This conception of a differential stage that precedes mediation and mediation's becoming-subjectivized or -objectivized is similar to an electric field of electrostatic vectors and it is no coincidence that Simondon often recalls such electrical fields often in his writing.

For Simondon, these two ideas—matter and field/neutral foundation—are related to one another, as demonstrated in his references to the (preindividual) 'found' [*fond*] as the background upon which a form/figure may emerge:

> …there would not only be a genesis of technicity, but also a genesis on
> the basis of technicity, through the splitting of an original technicity into
> figure and ground [*fond*], the ground corresponding to the functions of

totality that are independent of each application of technical gestures, whereas the figure, made of definite and particular schemas, specifies each technique as a manner of acting. The deepest reality [*réalité de fond*] of technics constitutes theoretical knowledge, whereas the particular schemas give us praxis' (2017: 171).

For Simondon, matter is like a field with differences in potential; forms emerge *in* matter and they are not given *a priori*. Form is not *a priori* imposed onto undifferentiated matter but, instead, forms emerge through a process of individuation.[40] For Simondon, given the technical operation that gives rise to an object with form and matter, the dynamism of this operation simply *cannot be represented by the matter-form pair*. Unlike the Hegelian dialectic based on the notion of identity and non-identity—the opposition between 'A' and 'not-A', or 'I' and 'not-I'—Simondon's work on relations seeks to explain the genesis of phenomenal reality (including the objects populating it) and the subject by way of a dialectic founded on the idea of the *differential*, rather than contradiction.[41] Difference, as indeterminate and preindividual variation, is not the limit between two given identities but a non-phenomenal condition of all identity engendered as a determined object of and for thought. Simondon's differential relations place media in relation with their spatio-temporal relations of realization; this kind of infinitesimal difference accounts for genesis outside of the self, understanding the real/actual non-phenomenal conditions of the process of individuation of thought. As with Deleuzean difference, Simondon's difference can be linked to the model of calculus, which maps the processes by which thought determines itself on the basis of that which is non-phenomenal, on the basis of the differential (the *dx*). As a process of actualization or becoming-*differenciated*,[42] individualization is always and necessarily a genuine creation. Progressing by way of spatio–temporal dynamism, a differentiated idea is *differenciated*—it is a process of individuation in the sense of dramatizing the idea, producing an 'indistinct differential relation in the Idea to incarnate itself in a distinct quality and a distinguished intensity', with the result being that 'the individual finds itself attached to a pre-individual half which is not the impersonal within it so much as the reservoir of its singularities' (Deleuze, 1996: 245, 246). Railing against hylomorphism, Simondon remarks that '[t]he form and the matter of the hylomorphic schema are an abstract form and an abstract matter' (2020a: 22), where:

> [t]he hylomorphic schema is thus a couple in which the two terms are clear and the relation obscure [.... And] represents the transposition into philosophical thought of the technical operation reduced to work, and taken as a universal paradigm of the genesis of beings. It is indeed a technical experience, but a very incomplete technical experience that is at the basis of this paradigm. The generalized use of the hylomorphic schema in philosophy introduces an obscurity that comes from the insufficiency of this schemas technical basis' (2017: 248).

For Simondon, as in the example of a brick, definite Being does not result from the combination of unspecified matter with unspecified form (where form is imposed upon the brick). Simondon criticizes this Aristotelian hylomorphic model that presupposes *a priori* forms—for Simondon, there are only forms insofar as they are co-determined by a process. Thus we do not need to turn to Whitehead or Deleuze for processual construction of subjectivism that emerges bottom-up.[43]

Simondon's considerations of practical reason recall C.S. Peirce, where we have knowledge which depends on actions/decisions that are taken. Similarly, knowledge for Simondon is a *know-how*—to learn how to cope with environment, to make accurate predictions related to this environment, and so on. Knowledge as such provides us with a means of selecting important information in order to react in appropriate ways and to achieve a specific goal. For Simondon, the process of individuation is not so different from this idea, such that decisions taken or the knowledge of an environment that one has is not *absolutely true* but, instead, true relative to an appropriate solution to a specific problem. Accordingly, Simondon provides us with an intersubjective conception of environment; the creation of knowledge necessitates the most efficient way of actuating a goal.[44]

We also ought to note that all communication for Simondon is *prelinguistic*. Communication as such is exacted by way of individuation; during this process of individuation, there is a sort of negotiation by way of action. As it involves the actant, action always forms a rapport with a discrete part/element such that the other part/element has to act in response in order to preserve its own equilibrium. Little by little, both elements 'learn' how to interact; signification is the selection of or the

capacity of recognizing specific actions or affects coming from the environment or milieu. Thus, Simondon remarks that:

> [t]he emergence of the distinction between figure and ground is indeed the result of a state of tension, of the incompatibility of the system with itself from what one could call the oversaturation of the system; but structuration is not the discovery of the lowest level of equilibrium: stable equilibrium, in which all potential would be actualized, would correspond to the death of any possibility of further transformation; whereas living systems, those which precisely manifest (2017: 177).

Simondon's description of communication provides us with a rich philosophy of becoming. Consider how this structuration would apply to, say, bacterium; bacterium are not 'intelligent' (i.e., sapient) and do not have a language but, nonetheless, are able to move within and through their environment in order to find food by discerning pertinent signs (e.g., difference in sugar in water). Thus, the bacterium selects different intensity from a signal or environ that is significant for it, matching exteroceptive and interoceptive inputs; the bacterium does not visually 'see' anything but, by way of differential patterning, becomes sensible to difference(s) in degrees in relation to the substance it is interested in, which allows for it to move effectively and *knowledgably—to move with reason*. This top-down analytical approach allots a kind of prediction-error. This is what Simondon means when he designates signification before language (i.e., it is 'prelinguistic'), where intensity is precisely that which allows for reaction. *In their being non-representational, deep learning neural networks are, similarly, prelinguistic.* Consider how deep learning systems like AlphaGo Zero use previous data as a signal-processing heuristic to predict future variances.[45] Simondon's notion of transindividuation, as applied to the bacterium, is not terribly different from how deep learning algorithms like AlphaGo Zero pluck certain pertinent data to 'train' themselves by way of patterned-reinforcement learning.[46] Just as sugar serves as the basic observational empirical data for the bacterium, for predictive patterning there exist protocol statements/propositions. With machine learning, the probability of any hypothesis is not determined *a priori* but determined by way of conditions and implementations. Similarly, for Simondon transduction is never exterior to the terms

that it brings forth, patterning through the inherent tensions in a domain (2020a: xxiii).[47]

Often, the roots for this kind of paradigm are linked to Carnap's *confirmation theory*, which provides an outline of the acquisition of knowledge from experience. Specifically, in *The Logical Structure of the World* ([1928] 2003), Carnap defines an explicit computational procedure for extracting knowledge from elementary experiences. For Carnap, Simondon, and the kind of inferential machine learning logic that we are interested in—i.e., a Bayesian statistical logic that cannot be explained away with the extension of mind, intention, or memory, but navigates a differential space—objects deal with and restrict themselves to structural properties.[48] That is, objects are *objects of form*, where objectivity is structured by way of intersubjectivity, the dimensions of form structuring and holding together individual strands of content. As a consequence, the sole reason objects of knowledge are possible is because despite 'the material of the individual streams of experience is complete diverging … certain structural features agree of all streams of experience … objects of knowledge are not content, but form, and they can be represented as structural entities' (Carnap, [1928] 2003: §66). This hierarchy allots deep and varied empirical Bayes in a prediction error landscape where prior probabilities are 'empirical' in that they are learned and pulled down from higher levels, such that they do not have to be extracted de novo from the any current input. In terms of a bidirectional multilevel hierarchy, the upper layers of the network form 'top-down' predictions upon the basis of which data coming from levels below is assessed, where past certain thresholds of tolerance error signals 'trickle up' in a feedforward manner, triggering the system to revise its predictive models. This reliance on higher levels means that processing at one level depends on processing at higher levels. Such priors are bifurcated into hyperparameters (re: expectations of means) and hyperpriors (re: expectations of precisions).[49]

The pluralism of an open-ended form of practical reason is fundamental in this model of technical- /machine-communication insofar as it is reason-guided; a framework is not chosen by an individual but revealed preferences, a social process of some kind moving through a regulative ideal (Carus, 2017: 178). For Simondon, individuation has its own signal and signification, which are rendered functional to

the being's relation with its environment. How, then, do we go from here to (object-)language? First and foremost, we have to consider the operative importance for this process of selection by way of intensity or degrees, which allows for the distinction of further definition(s) by way of signification. Machine language depends on specific individuation. This same process is the case with logic or any formal mode of thought, but this occurs in opposite fashion. Concepts arise by way of a specific interaction with formal language and any specific process of individuation gives origin to concepts, which are useful for coping with a specific environment:

> '[t]echnical 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. This relation between technical objects is of a problematic type, insofar as it puts indeterminacies into correlation, and for this reason it cannot be taken on by the objects themselves; it cannot be calculated, nor be the result of a calculation; it must be thought, posed as a problem by a living being and for a living being' (Carus, 2017: 157).

Simondon's idea of indetermination corresponds to our previous discussion of *potential* and prediction-error. For Simondon, any individuated being has a functional relationship with its environment whereby its *relation(s) can change*. This indeterminacy means that change/becoming in technical objects cannot be tied down to a doctrine of representation/the image; for Simondon, the concept of information is important for any 'calculating machine' because calculations cannot observationally 'feel through' the environment (much like the aforementioned bacterium), at least not by way of the same kind of sensorial feeling(s) that humans and most animals possess (using qualia/epiphenomena/sensa). Nonetheless, machines are sensible to information and this sensitivity is what Simondon is interested in via indetermination; for Simondon, communication, data, and information are all entangled in the world of actuality. Recall that, for Simondon, information is a general term for the intensities which cause reaction and affection; in computing machines, this is a process of information coming into a coupling with respect to the machine, causing it to act or react in some way. Similarly, Carnap's conceptual engineering of constructivism is anti-representationalist, as the fruitfulness of a

concept motivates its adoption into certain contexts where said application had not previously been used. While we will not be following Carnap into the woods of symbolic logic, the bridge between Simondon and Carnap has been constructed simply to assert that, in addition to evincing a picture of second-order cybernetics—invoking principles of autopoiesis by challenging Wiener's conception of information and homeostasis—Simondon's conception of individuation by way of transduction (like Carnap's problematization of inductive logic) deals with *real relations between individuals*. Unlike Stiegler, who does not work with any measure of *measurable loss* in his cynicism towards digital networks (for Stiegler, 'neganthropy' corresponds to an idealist noesis), Simondon's concretization—the engine of individuation—asserts that we are interested in *specific results*, which can only be understood by way of a system's changes (and, invariably, its equilibrium).

From Second-Order Systems to Deep Learning

Let us now turn to the final section of our study—deep learning through the Simondonian schema of technics, individuation, and concretization. A particularly pertinent approach to understand the higher-order representational abilities of sentient and sapient cognitive behavior is the predictive processing paradigm (hereafter: PP), which explains how cognitive systems generate 'representations' of various phenomena on the basis of incoming information by way of a procedure called 'prediction error minimization' (Hohwy, 2013). Parsing deep learning by way of Anil K. Seth's Bayesian modelling of the cybernetic brain and his work on PP, we shall endeavor through some of Simondon's work on ecologies of influence, with a particular interest in objects (esp. networked digital media objects vide computation), infrastructural operations, and formal planes of reference.

According to certain cultural commentators, the epochal cultural development of 'deep learning' invokes a shift from linear Cartesian thinking towards intentional obfuscatory 'black box' de-spatialisation. Frank Pasquale remarks that, rather than intelligibility, fields such as 'actuarial finance'—increasingly privy to high-speed trading via AI —cultivate a sense of 'secrecy', establishing a barrier between 'hidden content' and penetrability, where the former is associated with the machine's and

machine learning's top-down mereological parsing of Big Data sets and unauthorized access to its endogenous encoding on behalf of the 'user' (Pasquale, 2016: 16). Similarly, Cathy O'Neil likens data-based mathematical complex computation to 'Gods'—impenetrable and 'opaque, their workings invisible to all but the highest priests in their domain: mathematicians and computer scientists' (O'Neil, 2017: 3).[50]

Broadly speaking, Big Data and its computational methods have bolstered the long-term construction of our datafied algorithmic reality; the future implications are drastic, with implications including predictive policing, hiring practices, credit assessment, and criminal justice. Thanks to the widespread cast of today's digital networks and the resulting availability of metadata and data we see why the neural metaphor that was once popular with early cybernetics researchers may make sense to invoke once more.[51] Like the connective conditioning of synaptic connections between neurons that have previously fired together,[52] Big Data allows for activity-dependent plasticity where causal lines are quickly cemented and, subsequently, capitalized upon by marketing campaigns. Jointed research in reinforcement learning has also resulted in a milestone for AI research. Using the logics of Hebbian associative learning and Monte Carlo 'tree-search' algorithms,[53] 'deep learning' and its Generative Adversarial Networks are predicated upon a scaffold that probabilistically retrofits output; that is, given samples are drawn from two competing models fighting against each other, with a generative model capturing data distribution and a (competing) discriminative model distinguishing training samples while, simultaneously, generating fake data samples. Given large sets of sampling data, training data has likewise burgeoned, resulting in the strengthened self-reinforcing process that Bernhard Rieder calls 'computerization',[54] thrusting deep learning research into celestial zenith.

The 'Monte Carlo' framework is deserving of closer examination. Christened 'Monte Carlo' after the gambling mecca, this analytical calculating method (developed during and shortly after WWII) utilizes simulative recall-and-precision while implementing random numbers (a la roulette) so as to simulate stochastic processes that had, until that point, been too complex to calculate. As an early example of analytical virtualization (and, arguably, virtual reality) the Monte Carlo method 'came to constitute an alternative reality—in some cases a preferred one—on which

'experimentation' could be conducted' (Galison, 1996: 119) By modeling a sequence of random scattering on a computer, the Monte Carlo sampling method ushered in a new epistemological plane for extracting information from physical measurements and equations. Its scheme of representation presupposes *an ecology* composed of discrete entities that interact through irreducibly stochastic processes. The Monte Carlo method, borrowing from both experimental and theoretical domains, negotiates the traditional categories of experimentation and theory; Peter Galison identifies this shift in the calculating machine as a development from 'computer-as-tool to computer-as-nature' (1996: 121).

Such technological changes, ushering in epistemic evolutions, necessitate paradigm shifts in how we understand technicity; this is a specific feature inherent to Simondon's concept of concretization, the engine of conceptual technicity which attunes network objects to the sensitivity of local circumstances. Previous to Monte Carlo and neural networks was von Neumann architecture—von Neumann's work on infinite random generators allowed for the sequential repetition of a finite cycle of numbers ad infinitum within a finite machine. Instead of treating cognition (esp. memory and intention) as a process that is extended by and through technical systems, convoluted neural nets constitutively 'remodel' themselves iteratively and reactively, proffering unique outputs which human players have, so far, been unable to predict. AlphaGo Zero, the Google DeepMind neural network that recently defeated the world's highest-ranking Go player, Ke Jie, and 18-time world Go champion Lee Sedol, is perhaps the most celebrated example. AlphaGo Zero's novelty is a byproduct of using the aheuristic 'tree search' pattern recognition,[55] simulation, and backpropagation to probabilistically account for simulative scenarios: by iteratively building partial search-inputs with which to update its 'weights'—or the default values of selection—such neural nets are able to start at a root node and recursively create non-terminal values that are revised according to 'backpropagation', or how simulated error scenarios unfold as a reactive gradient of layering. Multilayer 'feedforward' neural networks such as AlphaGo are not only based on binary classification or principles of registration but on an ecology of data which is elliptically remodeled according to a hierarchical scaffold, constructing an evolutionary closed-loop evaluation mechanism that optimizes according to the current action in question.

Advances in Bayesian networks and statistics are inseparable from these developments. The Bayesian approach calculates probabilities for various hypotheses in terms of degrees of certainty and 'is ideally suited for situations where one might want to begin calculating probabilities for different hypotheses (e.g., concerning class membership) even if very few observations are available, continuously updating and refining prior probabilities as more evidence comes in' (Rieder, 2020: 245). Bayesian networks are acyclical, directed graphs, illuminating model dependencies with nodes connected through the latticework of probabilities.[56] In the case of machine learning, Bayesian classification allows for the capacity of algorithmic techniques that move between application domains where there are 'habitats'—data sets and classification characteristics—where one set of techniques burgeons and another diminishes. With deep neural networks, this involves modeling complex non-linear relationships between input-variables and output-classes distributing calculations over parallel hardware. This technique is i) perceptual, and ii) apperceptive: at once a model based on image-detection, the empirical frame of registration and recognition found in first-order cybernetics; but also dealing with internal-classification based on advanced graphics processing where the most salient features are weighted according to df-idf frequency.[57]

This sets the stage for an epochal dilemma re: contemporary computation's internal logic. Were we to take syntax-based classical deductive computing, such as the Universal Turing Machine, as an ideal model (plucking neural nets from the mid-to-late twentieth century), we could characterize the parsing of information as a linear spatial procedure—one composed of sifting through data by moving forward and backward as information is divided into procedural units and consequential steps. However, 'deep learning' algorithms, as recently exemplified by advancements in reinforcement-learning AI (such as AlphaGo Zero), seem to 'experience' data opportunistically. Such deep learning software are able to decisively re-integrate evaluative metrics that deviate from a sample-proportion.

Sybille Krämer and Horst Bredekamp, describing contemporary advances in computation at the level of cultural techniques, remark upon the long-term effects of computerization, noting that:

> …cultural techniques are promoting the achievements of intelligence through the senses and the externalizing operationalization of thought processes. Cognition does not remain locked up in any invisible interiority; on the contrary, intelligence and spirit advance to become a kind of distributive, and hence collective, phenomenon that is determined by the hands-on contact humans have with things and symbolic and technical artefacts' (2013: 26-27).

Here, Krämer and Bredekamp describe calculus as a 'mechanism of forgetting' (26), exacerbated by how computation implements operative signs and mathematical competence sans-reflection. The duo thus liken computation qua calculus to Stiegler's and Derrida's reification of the *hypomnēmata*; the two see the register of computation as externalizing cognition from the invisible interiority of the minds of individuals by way of distribution, shooting forth these grand prostheses which not only make perceptible that which was cognitively invisible but operationalize dissociation into previously unforeseen heights. Stiegler, Krämer, and Bredekamp recycle a pessimistic tale that ensnares the planetary apparatus of computational becoming where the sole means of recovery amounts to re-interiorizing that which has been computationally exteriorized. [58] Recall that the mission of Hegel's phenomenological propaedeutic investigation into the structure of thinking, raising it to the ideal of a 'presuppositionless science', was to determine that even appeals to sensory immediacy at the ground of experience are always already mediated by the concept. But this concept finds a sea change in such thinkers of digitality, for whom a new concept of networked misfortune has taken anchor.

Has the automation of intelligence left the biological human organism behind, with the human organism reduced to the reproductive organ of the machine phylum, thus fulfilling the role of a pollinator for machine reproduction? This fear far predates computerization. This is, in fact, what Samuel Butler, in his books *Darwin among the Machines* (1863) and *Erewhon: or, Over the Range* (1872), prognosticated with the intensive spatium of impersonally structured thought.[59] André Leroi-Gourhan carries such fears of the *organized inorganic* into the terrain of self-obsolescence in *Gesture and Speech*, foreseeing the biotic human as a fossil in the technosphere, with the human motor brain exteriorized in the last instance and, accordingly, captured by

autonomously locomoting robots, total mechanicity commemorating automation's final hour.[60] Today, such fears of transhumanism run rampant haunt the popular imagination, the incubus of a fully automated future aggravated by conspiracies of synthetic pathogens and weaponized pandemics. Compounded with Pasquale's 'black-boxing', these fears paint a horror-stricken scenography of humans not only tethered to our machinic overlords but utterly unable to comprehend their masters' whims—outflanked and outpaced, a picture of man succumbing to 'parasitism-as-atrophy-of-individuation' (Moynihan, 2020: 85). Nonetheless, mustering philosophical concepts alongside historical-archeological technical pursuits shows that such is not the case (at least not yet)—there is still a great deal of contingent genealogical residue between mankind and even the most advanced deep learning algorithmic logic.

Functioning like brains, deep learning algorithms engage in predictive inference, working through the causes of sensory- or data-inputs by *minimizing prediction-error(s)*. Anil K. Seth has been one of the foremost thinkers in philosophy of mind and researchers of PP to show how the predictive perception of sensorimotor contingencies originates not in the Helmholtzian principle of perception-as-interference but in 20th century cybernetic principles that emphasize homeostasis and predictive control (i.e., second order cybernetics). Seth, drawing on Ashby's work on homeostasis, builds on the *Law of Requisite Variety* by arguing that the nature of a controller capable of suppressing perturbations imposed by an external system must instantiate a (virtual) model of that system. Interestingly, the paradigm of PP not only allots us with a description of algorithmic intelligence's patterning-based derivability but, in turn, how neuro-inferential mentality occurs by encoding such patterning. This Bayesian model of mind anchors rationality as a formal-computational reformulation of inductive reasoning, whereby cognition is a process of directing order out of noise. As Seth demonstrates, the PP paradigm proffers an analogy of mental 'self-modeling' whereby the rational agent is denied epistemic access to *how* exteroceptive perception is patterned, as active inference involves source-detection and 'seeking evidence that goes against current predictions, or that disambiguates multiple competing hypotheses' (Seth, 2016: 24). Neural network research has proven to illuminate great insights into how our own neural processes work, destabilizing the standard model that pairs 'figurative projection' with

phenomenological centering. As Seth's research in phenomenal representation shows, the perceptual presence of disambiguation is one of counterfactually rich and relatively perspective-dependent integration.

This gives us a spatial ecology of mind and perception. If, for instance, we take a tomato on a plate, the mental representation of the tomato is causally integrated via the plate's presence. Similarly, recalling Simondon and the bacterium, we can consider how the sugar-content is embedded in a functional field of engagement, a restricted environment. Such material-biological codetermination is the product of restricted horizons, where restrictedness decisively determines how sentient organisms are to be conceived of as *ontological configurations* (Puntel, 2008: 276). In both examples, causal contact with all other objects in the perceiver's vicinity informs the derivation of relevant information out of noise. Consequently, spatial perception is based on a kind of signal processing where 'objecthood' is embedded within a causal ecology of spatio-temporal relativity. The tomato and the human perceiver are, in a sense, 'flattened', with scalar inversion dependent upon relative ecological contingency—the tomato plays as much of a role as the plate does in distinguishing one object from another; this logic can be extended for objects that are less visually explicit, as their pertinent features are operative modal instruments nonetheless. As Reza Negarestani remarks, recalling the work of the late Carnap, such *source detection* is possible insofar as the estimates are probabilistically constrained such that they are hierarchically organized in order to track features at unique temporal and spatial scales that predict one another (Negarestani, 2018: 162-163). This is precisely the logic of unsupervised deep neural networks like Alpha-Go, which, engaging in iterative development through self-play, learn vide randomized training data, achieving stability by way of discerning operations into patterns of structure-preservation for the conceptual and formal dimensions guiding theoretical constructions.

Coordinating itself to its environment, such a simulative system produces an ever-more accurate 'map' of the world to which it belongs. Source detection, in principle, is not simply circumscribed to the semblance of data but invokes complex theory-forming systematizing conceptual abilities that theoretically map and intervene upon the world by plucking and hierarchizing features that are most pertinent. Perceivers

of red tomatoes, sugar-patterning bacterium, and sample-training deep neural networks similarly imbed the informational indexes that they register from the environment in a conceptual and formal theoretical context that makes explicit the objective modal structure of the world. In the case of deep learning this means that there is, beyond the ontological framework, also a more fundamental theoretical framework that becomes adaptively activated as, wittingly or not, the concepts that are at first solely granted theoretical use-value eventually acquire observational ones, without implying that the concepts designate or describe changes. To perceive something *as something* involves an active contribution by the thinking mind, through which agents extend their differential *capacities* (again: the concepts do not change) in relation to their environments, binding their labeling responses to sensory stimuli into counterfactually robust relations of incompatibility and consequence. Perceptual reports are non-inferentially prompted into epistemic challenges—observational concepts and perceptual reports are every bit as liable to assessment and revision as any theoretical concepts which have no perceptual uses but only inferential ones. And while observational concepts 'ground' empirical knowledge insofar as they articulate conceptual responses to environmental inputs coming from sensation, this does not mean that those concepts are 'Given' in the sense of foundational items of knowledge that are epistemically independent (Sellars, 1965).[61]

This is one important tenet of the PP model's conceptual construction.[62] It ought to be qualified by how it demonstrates the human unconscious' relative influence on bottom-up coding, thus summoning Kantian apperception.[63] In fact, the PP model recalls several themes from Kant's work on mentality, emphasizing: the 'top-down' generation of perception, the role of 'hyperpriors', the function of 'generative models', the process of 'analysis-by-synthesis', and the crucial role of imagination in perception. Consequently, the PP paradigm echoes Kant's transcendental project as it explains how the mind tracks causal structure in the world through solely sensory data (Swanson, 2016). However, this approach emphasizes the global Euclidean structure, which, as Carnap's *Der Raum* (1922) demonstrates in its chapter(s) on mathematical space and physical space, can be amended to tie the Kantian conception of intuitive space to the methodological role of constituting the framework for spatial judgments in experience. According to Carnap, Kant was incorrect in thinking that three-dimensional Euclidean space is an *a priori* necessary

condition of the possibility of experience—while Kant was correct in regarding the experience-constituting function of space, this system needed to be generalized. Here, Carnap uncovers how the constitution of spatial structure serves as a condition for all possible object-experiences and, therefore, how this relational constitution informs intuitive space and its logic, shaping the conditions of all successive objective experience. Similarly, for Simondon relationality effectively has the value of truth and is key to knowledge, such that both the relation within the subject and the relation between the subject and the object obtain the value of reality. Thus, true knowledge is not a simple formal rapport between an object-substance and a subject-substance but a *relation between two relations*, one of which is in the domain of the object and the other of which is in the domain of the subject; subject and object are, thus, understood by way of degrees of stability (Simondon: 2020a, 76).[64]

For Carnap, the spatial system possessing experience-constituting significance, in place of that suggested by Kant, can be precisely specified as a *topological intuitive* space with indefinitely many dimensions. Thus, not only the attributes of the system but also that of its order-framework (i.e., corresponding formal space) are declared to be conditions of possibility insofar as object-experience is concerned. Here, every differential manifold is considered locally homeomorphic—local topological structures layer elements of perceptual experience uniquely, presenting them with necessary form independent of whatever freely chosen metrical stipulations are laid down by convention (Carnap calls these 'optional determinations'). This provides our perceptual experience with a structure of intuition in something akin to the original Kantian sense but is extended to 'intuitive space'. However, any 'necessary form'—i.e., form necessary for 'knowledge'—is made intrinsically explicit in perceptual acts and representational systems. At the most general level, the way in which a representational system—including that possessed by humans, bacterium, deep learning systems—maps its environment depends on the structure of its 'locators,' which define how a system discretizes data and conveys information relative to an address or coordinate system of variable dimensionality, where the latter specifies the number of parameters required for precise localization. Localization, equipollent to representation, works at the most fundamental level of empirical organization, as a system's coordination to its environment is characterized in terms of reliable differential responsive dispositions (Brandom, 2007: 653). Localization is therefore a

base-level ostensive operation which guides a system to navigate its environment and reliably track phenomena within it (Ladyman & Ross, 2007). Such causal regularities span the most fundamental kind of information-processing system, where variable inputs are systematically correlated with specific outputs, to those such as AlphaGo, which use simulative play and backpropagation. In a broad sense, one can say that such systems 'classify' their environments by evincing such differential responsiveness, making patterns from updated forms; such patterns are not only a ubiquitous feature of the natural world but universal when engaging with and mending the world's objects, mediating them into media.

Following this distinction between associative spatial stability qua differential relationality, we can challenge Kant's contention concerning the significance of space for experience via the three-dimensional Euclidean system and extend this to the probabilistic paradigm of cognition, which emphasizes pattern recognition. In the 'feedforward' neural networks that occupy our interest and Hansen's, alike, top-down signals instantiate a matrix of possible causal structure(s). Simultaneous to this top-down generation of prediction is the bottom-up neural signal flow against which the predictions are matched—this is, therefore, termed the 'recognition model'. The PP paradigm emphasizes that the knowledge of *how to generate patterns* is actively used in order to *recognize incoming patterns*.[65] As Andy Clark notes, 'instead of attempting to directly train a (synthetic) neural network to classify images, the network first learns to generate such images for itself' (Clark, 2015: 27), not by simply checking them against a database of previously-encountered images but by identifying endogenous rules, or 'imagination procedures', that the network utilizes to generate incoming stimuli for itself. This has become increasingly significant as we move away from the methodological aperture of recollective storage-and-retrieval modalities, or '*token instances*' (Lake et al., 2015), and conceive of deep learning algorithms that match human performance as differentially surjected, considering sensation and perception as complimentary twin concepts rather than processes that follow one another. Thus, 'perception would not exist without the differential utilization of sensation' and the apprehension of relational structures between objects (or between the body and objects), while the operation of sensory differentiation can only be coherent with itself if it is made compatible by another activity, the activity of integration by way of perception (Simondon, 2020a: 230).

For Kapp, Leroi-Gourhan, and Stiegler, externalization is accomplished by way of alienating and projecting some contingent thing (mind, memory, intentionality) out of the body: the movement of externalization mirrors the dialectical structure of Hegelian subjectivity and its transcendental origin. The ideality of any concept or representation is always seen as the negation of the immanent real and its sublation into a higher (that is, transcendent) level of abstraction. However, knowledge, itself, is not unmoored by way of novel automatisms of exteriorizing interiorization and outpouching informatic exchange as Stiegler would have us believe; knowledge, being differentially determined, is always subject to its ecology. Regardless of what language we use—whether it be Hansen's/Whitehead's, Simondon's, or Carnap's— one point is clear when it comes to 'feedforward' networks and deep learning: rather than a return to Kapp's 'organ projection' where deep learning's nervous architecture and its sensory arrays are treated as an eversion of the human brain and its axonal synapses, networked into computerized threads, we must divaricate the procedural logic of the brain from its purported morphological export into the world of machines. Only then can we call ourselves responsible Prometheans and not despondent fatalists.

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Notes

[1] Similarly, André Leroi-Gourhan remarks that '[t]he whole of our evolution has been oriented toward placing outside ourselves what in the rest of the animal world is achieved *inside* by species adaptation. The most striking material fact is certainly the 'freeing' of tools, but the fundamental fact is really the freeing of the word and our unique ability to transfer our memory to a social organism outside ourselves' (Leroi-Gourhan, 1993: 235). Arnold Gehlen, in the same vein, also remarks that:

> Man is ultimately an anticipatory (*vorsehend*) being. Like Prometheus, he must direct his energies toward what is removed, what is not present in time, and space. Unlike animals, he lives for the future and not in the present. This disposition is one of the preconditions for an acting existence, and human consciousness must be understood from this point of view. Indeed, all the aspects of man, which should be kept in mind through the ensuing discussion, are actually elaborations of the basic characteristic of man—action. We shall see that many of the isolated statements about man are really developments of one basic point of view—that man represents Nature's experiment with an acting being (Gehlen [1940]: 1988: 24-26).

[2] Stiegler uses the term 'noetic' to describe this rationality; the term comes from the Greek *noesis* and Aristotle's *nous*, referring to the mind and to the understanding or awareness, which conditions human rationality.

[3] Stiegler, recalling Gilles Deleuze's 'Postscript to Societies of Control', often also remarks that technologies, analog and digital, are 'pharmacological' or serve as 'pharmakon', and thus are both poison and cure. Here, despite tracking in Derrida's lexicon (of the 'pharmakon'), Stiegler directly recalls Deleuze's work on 'control societies' where Deleuze, remarking on novel technologies that diffuse the techniques of disciplinary society that Foucault identified, notes new possibilities of repression and possibility. In an interview with Antonio Negri titled 'Control and Becoming', Deleuze notes that:

> The quest for 'universals of communication' ought to make us shudder. It's true that, even before control societies are fully in place, forms of delinquency or resistance (two different things) are also appearing. Computer piracy and viruses, for example, will replace strikes and what the nineteenth century called 'sabotage' ('clogging' the machinery) (Deleuze, 1995: 175).

Nonetheless, Stiegler's most recent publications, particularly *The Age of Disruption* (2019) and *The Nanjing Lectures* (2020), as well as his general identification of 'tertiary retentions' with 'disruption' and 'entropy', make clear that he identifies the artefactual capture of the earth as liquidating something primordial.

[4] In an interview with Matthew Griffin and Susanne Herrmann, Kittler remarks that:

> That the media influence bodies through emergence and immersion, on that point we both agree. However, I don't believe in the old thesis that thus the media are protheses of the body, which amounts to saying, in the beginning was the body, then came the glasses, then suddenly television, and from the television, the computer. The mythology is that everything frees itself from the body, dissolves and submerges in it again, in the sense of emergence and immersion, virtual reality, cinemascope, and hallucination …. I think to be able to describe a general media history, it would be better to work, like Luhmann, systematically from the independent histories of the technological media. The media don't emerge from the human body, rather you have, for

example, the book, and the military generals in considering how they can subvert the book or the written word, come up with the telegraph, namely, the telegraph wire; and then to offset the military telegraph, they come up with the wireless radio, which Hitler builds into his tanks' (1996: 739).

Kittler rejected this 'old thesis' that media function as prosthetic extensions of the human senses or of organs. In vigorously refusing this 'old thesis', Kittler preferred a more interventive and a system-theoretical relationship between media and organism, whereby tools establish culture.

[6] Similarly, Arnold Gehlen remarks:

Given the obvious absence of specialization in human organs…, any theory that claims that man is directly descended from animals and that does not resort to a special supplemental hypothesis to account for this particular issue necessarily confronts the insurmountable problem of deriving primitive forms from developed ones (Gehlen, [1940] 1988: 80).

[7] This moment of *anamnesis* is the moment of recollection and, in the Meno, the slave boy's drawing in the sand of the gymnasium serves as *hypomnēmata* (the monument) for memory—a stand-in for the essence of true memory itself (*mnēmē*); the artificial apparatus in question, the inscription, is a monument (or artefact) as it makes memory technical and serves as a substitute for *anamnesis*, extending memory. For Stiegler, this recovery from *anamnesis* formats the techno-transcendental condition of the human experience of time by way of *artefact-as-substitution*. In the era of digitality, for Stiegler this has a particularly insidious nature:

…as this apocalypticism without God that now haunts the entire world, given that since 2008 the consumerist model, by collapsing, has made clear that it is no longer just the financial objects of logos, constituted by their *hypomnēmata*, which in the twentieth century changed their meaning and social function, but also everyday and familiar objects – and, along with them, and since they alone can definitively undermine the foundations, *das Ding*, the Thing (Stiegler, 2018: 73).

For other philosophers such as David Chalmers and Andy Clark (and their theory of Extended Mind), digital technologies such as iPhones are normatively positive; the two point to how such technologies offer those suffering from neuro-degenerative diseases such as Alzheimer's the opportunity to offload memory onto devices/artefacts. According to Chalmers and Clark's Parity Principle, such external devices do not merely facilitate cognitive tasks but are in fact constitutive of those cognitive operations in question; cognitive states and processes extend beyond the brain and into the external world when those relevant parts of the world function in the same way as do unquestionably cognitive processes in the mind (Chalmers and Clark, 1998; Clark in Chalmers, 2008: ix). That is, a notebook or smartphone can be understood as cognitively constitutive if and only if someone consults it for directions where they would have otherwise had to consult their memory/memorize these directions. In this sense, Chalmers and Clark approach digital technologies with a more fine-tuned and function-oriented interest in mentality, rather than ascribing to the wholesale cynicism of Stiegler.

[8] Stiegler clearly co-opts Derrida's rendering of Plato (made obvious by Stiegler's use of the term *pharmakon*), which sees *hypomnesis* as a derided category and mechanical reproduction as normatively negative; Derrida writes in *Plato's Pharmacy* that '[t]he sophist thus sells the signs and insignia of science: not memory itself (*mnēmē*), only monuments (*hypomnēmata*), inventories, archives, citations, copies, accounts, tales, lists, notes, duplicates, chronicles, genealogies, references. Not memory but memorials' (1981: 107). Writing, as a dialectical simulacrum of 'true science', becomes a *pharmakon*.

[9] Stiegler most often uses the term 'exosomatization', which is a holdover from Lotka.

[10] Marshall McLuhan's oft-quoted apothegm, 'the media is the message' offers a cruder version of the same argument; while McLuhan is not a 'philosopher', it would not be wholly inappropriate to count him as a member within these ranks.

[11] Specifically, Canguilhem referred to it as 'general organology'.

[12] David Bates writes that '…cybernetics as a transdisciplinary science had its very origin in the insight that pathological physiological performances could be mapped, structurally, onto technological failures with mathematically identical characteristics. While Wiener and his colleague Julian Bigelow discovered that excessive compensation could lead to increasing oscillations that eventually became uncontrollable, leading to great disorder and a failure to find equilibrium' (2014: 33-34).

[13] By 'life' Canguilhem has in mind something akin to Henri Bergson's conception of *élan vital*, such that biology is vital, pre-existing the body or the mechanistic thinking of it. In turn, Canguilhem's 'general organology' allows the body to be understood as a machine, or in mechanist fashion, but asserts that there is a more primary biological primer which escapes this description:

> If vitalism translates a permanent exigency of life within the living, mechanism translates a permanent attitude of the living human toward life. Man is here a living being separated from life by science and attempting to rejoin life through science. If vitalism, being an exigency, is vague and unformulated, mechanism, being a method, is strict and imperious (Canguilhem, 2008: 62).

[14] For Leroi-Gourhan, technologies externalize memory in addition to liberating organs.

[15] According to Kapp, technologies (specifically, tools) externalize the body's organs; for Kapp, there is a morphological linkage between the organs inside one's body and the tools mankind crafts.

[16] Kapp writes that:

> As the human being makes use of the objects 'at hand' in its immediate vicinity, the first tools appear as extending, strengthening, and intensifying the human being's bodily organs. If, therefore, the natural hammer is the forearm with clenched fist, perhaps reinforced by a stone clasped in the hand, then the stone attached to a wooden shaft is its simplest artefactual after-image. For the shaft or the handle is an extension of the arm, the stone a replacement for the fist. Our reflections are limited here to a selection of figures belonging to the group of hammers, axes, and their nearest forms from the Stone Age, on the basis of their illustrative significance (Kapp, 2018: 36).

[17] Marx roots this in human social relations, which become objectified via commodities. Feuerbach sees this as within the ambit of human self-consciousness and Marx sees this as human practice (i.e., social production).

[18] Stiegler defies Hegel here by retaining the notion of a looming pre-existing external substance and identifying technical with outpouching some original and vital source, such that Spirit is something that has to be reclaimed. He uses the term "negentropy" to articulate this but, given the term's origination in thermodynamics, where it has a very specific meaning, we will avoid using Stiegler's term. More broadly, this paper seeks to strike a secondary concern: Stiegler is not only a traitor to Simondon but also to Hegel, despite following from a Hegelian lineage of philosophers of technology.

[19] For Hegel, '[t]he concept is free because the identity that exists in and for itself and constitutes the necessity of substance exists at the same time as sublated or as positedness, and this positedness, as self-referring, is that very identity' (Hegel, 2010: 513).

[20] One could also see the Hegelian Master-Slave dialect as a prosthetic relationship. For the master, the slave serves as the site of veridiction, speaking 'truth' only via instruments of veridiction (i.e., instruments of truth-expelling, instruments of torture). Here, the conception of political power is conceived of as pure affect; the master constitutes himself *as self* through the virtual embodiment and the disembodiment of slave in imposing the will. The slave thus serves as an archive for the master ,as the slave's body functions as a memory substitute (*hypomnēmata*)—the archival prosthetic, a supplement and archive of power (esp. Foucauldian power, where power is understood as a site-specific space of contingency by way of spatialization). One could also further note, recalling the mirror-stage in psychoanalysis, that the Hegelian master seeks recognition from slave, constituting himself by turning the slave into as mirror-device for master and, thus, further engaging in artefaction/prostheticizing the slave.

[21] For Hegel, the acting self and absolute spirit come into synthesis for in human expressions such as but not limited to art, religion, and philosophy. For Kapp, tools and instruments allow for such human expressions to actualize into becoming.

[22] For Brassier, this is a mistake: there is no self-relation uncontaminated by estrangement and only retrospectively through history can we discern between what compels us to be free and alienation. The estrangement of history is what befalls us and thus prevents us from being in complete possession of us.

[23] One of the most apparent weaknesses of this rendering is that, as a consequence, metalanguage is not foundational for spoken language but simply understood as a technic proper once it is externalized. Consider Stiegler's following remark:

> Today, Chomsky […] distinguishes innate language, which he also calls private language, or I-language (for 'internalized language'), from cultural languages, E-language (for 'externalized language'). This kind of notion is what leads Jerry Fodor to refer to what he calls 'mentalese'. And it is a catastrophe […] I myself consider that language, just like writing, involves a recoding of prelinguistic cerebral functions (communicational and cognitive—for example, categorization functions), but that language nevertheless did not exist prior to this recoding. As for 'private language', it is an internalization by psychic individuation along a circuit of transindividuation

that is originally social [….] The writing of which Wolf speaks is a more advanced form of that placing into exteriority that lies at the origin of language—an advanced form that changes language itself. But this is possible only because language is an originally social system founded on the artificial organ that the 'word' already is. (Stiegler, 2020: 218).

Stiegler thinks that the distinction between private and external language is 'catastrophic' because sociality precedes any idea of internalization. Yet, 'mentalese', or the language of thought, is never independent from socialization in its acquisition. Stiegler conflates the conditions for genesis of language with the conditions of its reproduction, as if Fodor thought that one could learn 'mentalese' in a vacuum. Stiegler is seemingly taking issue with the fact that 'mentalese' expressions are analogs of sentences and the syntax of spoken languages, claiming that Fodor takes what is a social artefact as a natural kind (i.e., the word). For Fodor, however, thought precedes spoken language and is not prior to thought. Thought is more primitive than discursive cognition and has a syntactical structure which mirrors some formal languages and much of natural languages. Stiegler, in, subordinating psychic individuation to techno-social individuation, unwittingly ignores the discursive experience of giving and asking for reasons in language games.

[24] *The Nanjing Lectures* (2020) were published after *The Age of Disruption* (2019), but the former are comprised of a series of lectures given between 2016-2019.

[25] Stiegler terms this process of losing access to the knowledge that allows us to exist as rational agents collaborating and self-organizing from our labor ('savoir faire') as 'proletarianization', which results in us becoming dependent on consumption and compensation to have a meaningful life ('savoir vivre').

[26] While Hansen talks about Google PageRank and data analytics companies, he does not actually parse the protocols in question nor their training logic.

[27] Throughout his literature, Stiegler speaks of 'retentions', whereby 'primary retentions' are sense perceptions, 'secondary retentions' are memories, and 'tertiary retentions' are media (culture mnemonics, which are further bifurcated into 'analog tertiary retentions' and 'digital tertiary retentions'). Stiegler, however, does not give us a theory or logic of complexity, such that we do not know when or what makes a media 'digital' in comparison to the 'analog'. This is rather determinantal to his system, as Stiegler subordinates psychic individuation to techno-social individuation, and, therefore, 'secondary retentions' (memory) to 'tertiary retentions' (artefacts). Other philosophers, such as Reza Negarestani, have remarked upon the how iterative computational construction is inherent to digitization, where digitality is a byproduct of deletion that is followed by generative supplementation. That is, digitality asserts its own logic of discrete systems that engage in Negarestani recalls that the domain of the digital is that of mechanizability, realized by deletion: 'discrete inputs, discrete states, and discrete outputs', whereby 'what is erased […] has to be replaced by new supplements—every figure loses something but also is supplemented with new lines and diagrammatic configurations [….] the shift from the analogue to the digital should be regarded as a veritable worldmaking. In this process, continuities are deleted' (Negarestani, 2018: 430). Rather than understanding 'the digital' as merely electronic machines and networks, as Stiegler seems to indicate, Negarestani (as well as others such as Alan Turing and Giuseppe Longo) have defined it as a system which reproduces itself/its rules and can be amended functionally, such that any in-world encoding has a system-wide effect, which ends with homeostasis.

[28] Heidegger, along with Derrida, is a primary philosophical influence for Stiegler (in treating technology as an epistemological rupture).

[29] Such relational study is central to Heidegger and his enumeration of technical objects such as the tractor in the field or the hut in the Black Forest.

[30] Hart, a computer scientist, was an acquaintance of Simondon who wrote the preface for Ninian Mellamphy's previous unofficial translation.

[31] For Graham Harman, the Heideggerian disposition in which objects withdraw from our epistemic and practical grasp serves as an ideal model for the noninteraction of all objects with one another in zero-sum terms. Harman's typology of change is directed towards functional ends, with an object either acting towards or against the system's end. Contra Simondon, for Harman 'vicarious causation' bars direct influence between entities/manifest qualities. For Harman alteration is a zero-sum game of drastic transformation or gridlock, after which change is barred. Therefore, Harman's necessitarian conception of stochastic transformation is accompanied by a subsequent non-initial theory of immunity. Harman's ontological argument for change maintains that change is only possible in a finite number of occasions and, in such instances, transpires in an extreme sense

(Harman, 2012: 171-206). 'Thing Theory' co-opts a similar, albeit something more sundry, conception of tools and machines.

[32] 'Reticulation', as opposed to 'networked', captures the concentric form that relations of differential influence take.

[33] For Simondon, *invention* is key, as it will serve as the socio-political beacon for his conception of the man-machine relationship; Simondon ultimately seeks to demonstrate how we can achieve a relationship that goes beyond the terms of Marxist alienation. In re-inscribing the technicity of knowledge, it is, for Simondon, the purview of *philosophical thought* to see the formation of a becoming-aware that builds upon the modalities of *aesthetic thought*, which allows for a mediated relationship between technical objects and their function.

[34] According to neuro-inferential models such as Predictive Processing, 'best' predictions are understood as those which enable control and homeostasis under a broad repertoire of perturbations, underscoring the functional boundary between controller and environment.

[35] Jean Piaget is a common point of reference for many second-order cyberneticists and Simondon. Remarking upon radical constructivism and radical constructivists, von Glasersfeld notes that:

> They have taken seriously the revolutionary attitude pioneered in the 1930s by Jean Piaget, the Swiss founder of cognitive psychology. This attitude is characterized by the deliberate redefinition of the concept of knowledge as an adaptive function. In simple words, this means that the results of our cognitive efforts have the purpose of helping us to cope in the world of our experience, rather than the traditional goal of furnishing an 'objective' representation of a world as it might 'exist' apart from us and our experience (1991: xiv).

[36] Here, in addition to Norbert Wiener, Simondon is referring to Claude Shannon, Ralph Hartley, and Ronald Fisher (whose surname he spells as 'Fischer'). There does seem to be an inaccurate conflation at play here as, for Wiener, information is a measure of degree re: organization in opposition to entropy (where entropy measures degree of disorganization; that is, for Wiener information is negentropic). For Shannon, information is the measure of degree of incertitude, or redundancy.

[37] Here, Puntel deals with moving from intelligibility as the fundamental immanent structural characteristic of the dimension of Being by enumerating on the *universal coherence of the dimension of Being* (where coherence deals with positive interconnections/systematicity) and *universal coherence as universal structuration*. For our purposes, we apply this structuration to Simondon's conception of communication and individuation.

[38] For example, given the history of evolution, Simondon describes evolution as a process of individuation; however, he is not interested in offering/adding a supplementary history of evolution—with Deleuze, the virtual is the potential of not simply one unique process (despite this process is, according to Deleuze, the process of 'becoming') but a process of actualizing various different processes. Of course, Simondon is an extremely critical source for Deleuze, but Simondon more directly informs when and how Deleuze describes *actual processes*—how beings co-hold or modify themselves as part of a machinic ontology, or how beings-cum-machines modify their reciprocal relations as they co-determine themselves.

[39] Simondon's notion of a pure genetic field tracks with William James' radical empiricism, where the world of pure experience is a world without subject or object (Henri Bergson has a similar conception of the field of pure experience). It is on this plane that, for James, division takes place and distinctions may be constructed. The plane/world of pure experiences is, for James, how the neutral point of the present is constructed. For Simondon and James, the instant field of the present is always experience in a 'pure' state, where the point of pure present whose thought does not belong to consciousness is separated from consciousness. Similarly, C.S. Peirce's classification of signs which only makes sense in light of semiosis, the function that the sign may perform; just as forms are always derived from a function that produces them, the signification of the sign is tied to the action of the sign.

[40] As readers of Deleuze may note, this will be most important for Deleuze's project. Deleuze—throughout his oeuvre—rigorously attempts to avoid the priority of forms/concepts over reality (contra Platonist internalism). Deleuze's project is committed to demonstrating how concepts are created and produced with respect to processes of individuation which occur *in reality*. For both Simondon and Deleuze, there are no *a priori* concepts which are imposed onto matter that are used *to order* or *create order* but, instead, concepts emerge as a consequence of differentiation of matter.

[41] This is a dialectic only in the formal sense, but it does not move through historical stable oppositional positedness.

[42] The process that Deleuze calls 'differenciation' roughly corresponds to Simondon's individualization; both are working against the Aristotelean model of 'potentiality' as for both, actual difference has a 'creative capacity' of its own, which Aristotle's conception of 'potentiality' does not; differenciation in Deleuze and individuation in Simondon is physical, corresponding to a distribution of singular and remarkable points. As Ray Brassier remarks, these points:

> become incarnated in a physical partition or a biological specification. Individuating difference is 'the disparate' or the dark precursor as differenciator of difference; the disparate generated by 'the disparity' of intensive difference. Ultimately then, individuation determines actualization, which unfolds according to the fork in being between expressing thought and expressed Idea. This fork is a function of the nature of intensity as enveloping and enveloped (Brassier, 2007: 174).

Alain Badiou describes *differenciation* vs. differentiation by noting that:

> [w]hereas differentiation determines the virtual content of the Idea as problem, differenciation expresses the actualisation of this virtual and the constitution of solutions (by local integrations)….Differentiation itself already has two aspects of its own, corresponding to the varieties of relations and to the singular points dependent upon the values of each variety. However, differenciation in turn has two aspects, one concerning the qualities or diverse species which actualise the varieties, the other concerning number or the distinct parts actualising the singular points. For example, genes as a system of differential relations are incarnated at once both in a species and in the organic parts of which it is composed (Badiou, 2000: 110).

Differenciation, like actualization, deals with discontinuous spatial structures; the differentiated problematic structure, different in kind to *differenciated* solutions, constitutes the domain of the actual. The genesis of determinable ideas, moving from differentiated to *differenciated*, from problem to solution, therefore moves from the virtual to the actual. One of Simondon's main influences on Deleuze is in distinguishing concrete actualizations of 'Ideas' by way of a distinction that makes and can be determined as difference (of difference).

[43] As readers of Deleuze may note, Deleuze's project is very compatible with Simondon's here, for Deleuze shows how concepts emerge within such a process of becoming—within this process of individuation. However, one point of distinction is critical: for Deleuze, the virtual is much more akin to Bergsonian virtuality—the virtual as a kind of past in its being a condition of a process (it is the past of a process, a condition or the being of a condition outside time). The virtual in Deleuze is an atemporal condition of a temporal process; this is why it is called *Aion*, or the time of eternity. In Simondon, there is no such conception of the virtual. Although Simondon engages with vitalism to some extent, recalling Bergson when he speaks of 'potential energy' and 'actual energy' (for instance, in his detailed study of transducers), this strategic implementation is more so in order to describe how there is homeostatic modulation in energy transference with such machines (e.g., Ashby's homeostat). There is no reason we cannot do away with Bergson's vitalism and codify Simondon's description of thermodynamic or homeostatic machines' moving from one state of constrained equilibrium to another via external manipulations.

[44] Note: although he does not *rely* upon it and only mentions it once, Simondon does recall Kapp's gesture when he states that 'for the tool is an extension of the organ, and it is carried by gesture' (2017: 130). Nonetheless, rather than tracing a biotic-morphological schema between the tool and the organ (as is the case with Kapp) Simondon's interest is more so in the organ as part of a complex system of organizations and this is not how he sees the machine. For Simondon science must be constructed on 'energetics and not just on a morphology' (2020a: 696). Elsewhere, Simondon makes a distinction between tool/instrument and machine:

> the tool is at once tool and instrument, which is to say a means of action prolonging the organs and a channel of recurring information. The machine, on the contrary, as a complete closed individual, replacing man, generally has no system of self-regulation: it goes through the motions of stereotypy of successive gestures according to a predetermined conditioning. The first type of machine is what one could call a mechanical being without self-regulation. It is indeed a practical technical unit, but not a technical individual strictly speaking (2017: 139).

Note: in this remark re: the machine without self-regulation, Simondon has in mind Wiener's conception of the machine-as-automata (without reference to interiority/autopoiesis).

[45] The heuristic in question is a perfect knowledge of the game's (i.e., Go's) rules; as we will further detail, the 'Monte Carlo' tree search algorithm (the 'engine' of AlphaGo Zero, allowing for rapid-action value estimation) does not need a supplementary heuristic function (there is no need for domain-specific knowledge).

[46] Interoceptive predictive coding's inference similarly utilizes prediction-error. This description is viable for homeostatic behavioral systems writ large. Consider how:

blood sugar levels (an essential variable) fall towards or beyond viability thresholds, reaching unexpected and undesirable values …. Under interoceptive inference, the following responses ensue. First, interoceptive prediction error signals update top-down expectations, leading to subjective experiences of hunger or thirst (for sugary things). Because these feeling states are themselves surprising (and non-viable) in the long run, they signal prediction errors at hierarchically-higher levels, where predictive models integrate multimodal interoceptive and exteroceptive signals. These models instantiate predictions of temporal sequences of matched exteroceptive and interoceptive inputs, which flow down through the hierarchy. The resulting cascade of prediction errors can then be resolved either through autonomic control, in order to metabolize bodily fat stores (active inference), or through allostatic actions involving the external environment (i.e., finding and eating sugary things) (Seth, 2015: 24).

[47] Simondon's 'transduction' is:

in contrast with induction and deduction, which do not have the status of being but are strictly logical relations exterior to the preexisting terms that they link up....an individualizing movement of knowledge, but also a movement of being, transduction is a form-taking in conjunction with the energetic discharge of the metastable system that is revealed as being more than unity and more than identity (2020a: xxiii).

[48] Given that Carnap and Simondon share an epistemological program of empiricism—where both philosophers' empiricism passes through a rationalist bottleneck (with Carnap's rationalist program transpiring towards the end of his career), the fact that we can construct a bricolage by way of emphasis on the structural descriptions of our knowledge and objects vide their environment should serve as no surprise. Simondon upholds an objective structure, but solely as this pre-individuated objectivity is constituted by way of the transformation of structures; in the last instance, Simondon's philosophy leans toward experience, knowledge, and the concrete. Much like Simondon's rejection of that which is absolutely true, preferring that which is instrumentally true (i.e., solving a specific problem), we have a similar idea in the Carnap of 1963, wherein the 'conception of the tools we use to choose tools are chosen in the same way and with the same tools that we use for object-level choices among goods or bets' (Carus, 2017: 167). Undoubtedly, however, Simondon is more sympathetic to metaphysics than Carnap.

[49] As Link Swanson remarks:

The top-down signals instantiate a generative model—a matrix of possible causal structure—which 'predicts' the causes of current sensations as it flows downward along the 'backwards' or 'feedback' anatomical neural pathways. Simultaneous with this top-down generation of predictions is a bottom-up neural signal flow against which the predictions are 'matched' or 'checked' (sometimes called a 'recognition model') and which flows along the 'feedforward' neural connections. (Swanson, 216: 7).

[50] In *Homo Deus: A Brief History of Tomorrow* (2018), Yuval Harari uses the term *dataism* to describe the phenomenon of data-fetishism/fundamentalism, where data processing systems take on the theological effects of blind worship.

[51] As Andrew Pickering details in his book, *The Cybernetic Brain* (2010), the idea of the cybernetic machine was shaped after the adaptive theory of the brain. This was particularly the case with firs-order cybernetics, with researchers designating the function of the brain organ as not a representation of but a means to understand processes of adaptation to the external environment. Understanding deep learning not only as a machine of cognition but one that operates with a logic similar to synaptic processes serves as highly valuable in understanding predictive patterning.

[52] Hebbian learning is an example of reciprocal modulation regulated by functional activity; here the synaptic connections formulate over time and are a byproduct of how the strength between two neurons increases if their activity is correlated (and decreases if it is uncorrelated; Hebb's law is often summarized with the adage: 'neurons that fire together wire together').

[53] AlphaGo Zero utilizes deep neural networks and heuristic search algorithms, specifically the 'Monte Carlo' tree search for searching through its strategic space when making decisions re: choice of play; AlphaGo Zero operates as a tabula rasa, and has been touted as 'superhuman'. Notably, it is:

> …trained solely by self-play reinforcement learning, starting from random play, without any supervision or use of human data. Second, it uses only the black and white stones from the board as input features. Third, it uses a single neural network, rather than separate policy and value networks. Finally, it uses a simpler tree search that relies upon this single neural network to evaluate positions and sample moves, without performing any Monte Carlo rollouts. To achieve these results, we introduce a new reinforcement learning algorithm that incorporates lookahead search inside the training loop, resulting in rapid improvement and precise and stable learning (Silver, 2017: 354).

The 'Monte Carlo rollout' (also called 'simulation') in question refers to the phase in which random actions are taken by the network to retrieve a landing state before another random action is taken in order to land in a new state. This process is iterated until a terminal state is reached. The terminal state contains a result (value) that is seeded upwards into the backpropagation phase, which updates the previous nodes by adding this result to their value, increasing the count of visits at each node. Such is the iterative relationship between selection and expansion in deep learning. The Monte Carlo tree search is crucial to such deep neural networks, providing sufficient numbers of parameters for algorithms like AlphaGo to conduct complex computations with (and, according to some, surpassing) human-level intelligence on specific tasks. This is achieved by its reduction and learning capacities in decision spaces and searching processes. Given our Simondonian frame, we ought not to overlook how critical the CPU and GPU are with large-scale parallel computing.

[54] Bernhard Rieder remarks that '…computerization rather than datafication emphasizes that data accumulation enables forms of 'immediate' management that operate through interface modulation. The direct application of algorithmic ordering is made possible by the emergence of digital infrastructures and environments that allow for both data collection and output generation in the sense that the structure and content of what appears on a screen or some other interface can be compiled in real time on the basis of data that may have been collected over extended periods of time' (2020: 36-37). 'Computerization' as such reifies Simondon's conception of technics, treating algorithmic information-ordering as inseparable from principles of design/architecture. Similarly, we ought to not neglect the social imperatives born out of social media platform capitalism. Given Rieder's fondness for Simondon, his attentiveness to such facets should serve as no surprise.

[55] Apart from game rules and conditions, the 'Monte Carlo' tree search algorithm (which consists of four phases: Selection, Expansion, Rollout/Simulation, Backpropagation) does not need any previous informational inputs such as strategy or tactics.

[56] Rieder details the example of spam filtering where 'building its model from the very first classified email and every additional act of labeling will produce an imprint while leaving room for future adaptation' (2020: 245).

[57] This is done by way of tf-idf (term frequency-inverse document frequency) where the frequency of a term in a document and its rarity in the collection are used to calculate its weight, which orders information according to statistical specificity by calculating feature distribution over a full collection of data, weighting different features to identify and project statistical horizons. Such term-weighting schemes add discriminatory power to information-and-retrieval modalities.

[58] Stiegler notes how '… a new social hierarchy could be constructed, based on a new stage of exosomatization, characterized in particular by the re-interiorization of exosomatic organs' (2020: 314).

[59] Butler remarks that:

> Is it not plain that the machines are gaining ground upon us, when we reflect on the increasing number of those who are bound down to them as slaves, and of those who devote their whole souls to the advancement of the mechanical kingdom? […] what an army of servants do the machines thus employ! Are there not probably more men engaged in tending machinery than in tending men? Do not machines eat as it were by mannery? Are we not ourselves creating our successors in the supremacy of the earth? (Butler, 1872: 201).

[60] For Leroi-Gourhan:

> Mechanical automation, from the mechanical brontosaurus of the nineteenth century rolling mill to the automatic pilot of today, represents the penultimate possible stage of the process begun by the Australanthrope armed with a chopper. The freeing of the areas of the motor cortex of

the bram, definitively accomplished with erect posture, will be complete when we succeed in exteriorizing the human motor brain. Beyond that, hardly anything more can be imagined other than the exteriorization of intellectual thought through the development of machines capable not only of exercising judgment (that stage is already here) but also of injecting affectivity into their judgment, taking sides, waxing enthusiastic, or being plunged into despair at the immensity of their task. Once Homo sapiens had equipped such machines with the mechanical ability to reproduce themselves, there would be nothing left for the human to do but withdraw into the paleontological twilight. (Leroi-Gourhan, 1993: 248)

[61] In the sense that they could be had without having another concept, or that they are self-justified in the sense that they could yield knowledge irrespective of other claims within an inferential procedure in which they play a part as premises or inferences for theoretical reasoning (Sacilotto, 2020: 150).

[62] We have detailed the PP model with great conceptual care, particularly with close regard to how training and empirical data are involved because, aside from Bernhard Rieder's *Engines of Order* (2020), media theory/archeology has not yet adequately dealt with training data, probabilities, and Bayesian epistemologies.

[63] For Kant, apperception corresponds to spatialized representation and is part of a tripartite mold consisting of: i) the apprehension of unity (simple intuition); ii) reproduction of unity in the imagination (distinction and juxtaposition); iii) summation, by which the self represents to itself a multiplicity in space.

[64] Simondon has a surprisingly similar critique of the Kantian *a priori* to Carnap:

…we cannot deduce as definitively as Kant a relativism of the existence of *a priori* forms of sensibility. If noumena are indeed not pure substance but also consist of *relations* (like exchanges of energy or passages of structures from one domain of reality to another domain of reality), and *if relation has the same status of reality as the terms themselves*, as we have tried to show in the preceding examples—insofar as relation is not an *accident* relative to a substance but a *constitutive, energetic and structural condition that is extended in the existence of constituted beings*—then the *a priori* forms of sensibility that allow us to grasp relations because they are a power of organizing according to *succession* or according to *simultaneity* do not create an irremediable relativity of knowledge (Simondon, 2020a: 75-76).

[65] Hansen's analysis of feedforward loops that mediate the data of causal efficacy via relativity takes a similar approach to the topic of subjectivity and media-operationalization. Hansen terms 'desire' what we have ascribed via pattern-recognition vide PP (Hansen's project is more phenomenologically cultivated and centers around 'data of sensibility'). Regardless of terminology, both frameworks show how the operation of speculation is brought into experience, dealing with deliberate decisions-making techniques. Hansen achieves this through Whitehead's account of process:

Like Whitehead's account of the incessant oscillation between concrescence and transition, every act of accessing the data of sensibility is itself a process that creates new sensibilities—sensibilities that are, in turn, added into the extant data of sensibility. This process of data propagation of sensibility perfectly captures the way that potentiality (Whitehead's 'real potentiality') correlates with the superjective dimension of process: far from being an inert source for computation, as it is often understood to be, data is quite literally teeming with potentiality, and specifically, with potentiality that—though part of the settled world—has a speculative relation to experience understood as the experience of consciousness. That is why, as we shall see shortly, data-mining and data analytics do not simply calculate a preexistent space of possibilities, but literally create new relations and thus new information (new data) as a result of their operation (Hansen, 2015: 142).

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