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Triangulate: Literature and the Sciences Mediated by Computing Machines

For centuries, the emergence of "literature" and the emergence of "science" have run a parallel course, oppositional, symmetrical, but also intertwined, entangled around a functional solidarity. The (in)famous "two cultures" needed each other to define themselves—often repetitively, and pointlessly[1]. Something, however, has thrown a wrench into this well-rehearsed debate since the 1940s: let's call it "computing machines." They write and they think, don't they? Just like literary folks, although not quite. They calculate and test and verify, don't they? Just like scientists, although differently. Since the advent of "deep learning," a.k.a. "machine learning," they even generate hypotheses: *hypotheses fingunt*, belying Newton who pretended not to, and mimicking fiction writers and theorists, who thought they were so quintessentially human. The (rather slow) emergence of computing machines upsets the traditional boundaries between literature and the sciences: it reveals deeper solidarities between them, as well as new contrasts. This article suggests that we may gain a better understanding and a firmer grasp on their present and future developments if we move from a cultural logic based on the binary opposition between two modes of knowledge (scientific *vs.* literary) to one that emerges from the triangulation of three forms of intelligence (scientific, literary, computational).

A couple of preliminary remarks about the status of what will be addressed as "Literature" in the following pages may prevent misunderstandings. Even if I have been "teaching literature" for more than three decades, on both sides of the Atlantic, I feel increasingly unable to define what the word "literature" may mean nowadays. Nor do I even know whether it ought to be used at all. I start my "Introduction to Literary Studies" undergraduate course by sharing my discomfort with my students: I ask them what they enjoy reading, viewing, practicing or listening to, and I tell them that whatever they will bring to class as enjoyable will be considered "literature" by my standards. This is the only literary way to teach literature I have been able to come up with. While I am confident that I might defend theoretically such an unorthodox (non-)definition of "literature," I understand the reader may find it unsettling, as we are about to set off for an assessment of the relative virtues and domains of the sciences, computation and literature. My point will be that it is of the essence of "literature" to question the meanings of the signs it uses, including those it needs to define itself and its function.

Three implications follow, however, which need to be acknowledged upfront. First, I will include literary studies (and not only literary creations) within the category of "literature," as one of its possible forms of experience. Second, I tend to treat the disciplinary specificity of "literature" as providing a platform of in(ter)disciplinary cross-pollination, and I tend to consider the "humanities" as reflexive modes of interpretation—which leads to a constant overlapping (and potential convergence) between literature and the humanities at large (see Citton 2010). Third, and more disturbingly, since scientific discourse or experiments, as well as computational adventures, can be claimed as enjoyable by my students—binding me to integrate them into my rather generous definition of "literature"—all the dichotomies discussed below between science, computation and literature will be provisional at best. I

[1] Many thanks to Monique Allewaert for her commentaries, suggestions, and input in the writing of this paper.

hope to show that even such an initial chaos of utmost confusion can result in an operational reconfiguration of our intellectual endeavors, once we reconsider it under the triangulation provided by computing machines.

The Great Divide

Let us start with a quick glimpse on the good reasons that led the previous decades (and centuries) to draw a foundational opposition between "the sciences," on one side, and "literature," on the other. I will briefly survey these dichotomies—ignoring their complex origins to envisage them mainly as they have been incorporated into our common sense. From the point of view of their *CONTENT*, the sciences have been identified as *referential*, insofar as they pretend to account for the ways our actual world presents itself to us, while much of literature has been seen as devoted to *fictional* entities. Science emanates from *Observers*, literature and the arts from *Imaginers*. Scientific inquiry provides a *descriptive* approach of the world we live in, while a majority of literary writings stage *narrative* trajectories within actual or possible worlds. Not only the natural sciences, but psychology too, are *outer-oriented*, insofar as they consider their objects of description from an external point of view, whereas literary inquiries can often be *inner-oriented*, accounting for perceptions and sentiments from within the worldview that is described.

As far as their *OPERATIONAL AGENTS* are concerned, the modern Sciences are reputed to progress through *collective* endeavors, teamwork and multi-authored articles, while modern literature is largely seen as an *individualist* activity. The former rely heavily on *technologically-equipped* procedures, while the latter, perceived as *artfully-crafted*, can always be minimally practiced with paper and a pen. As a consequence, scientific activity tends to be *expensive*, in order to pay for the equipment or staff it requires, while literary practices can come as *cheap* as the cheapest forms of food and lodging available.

From the point of view of their *METHODS*, the sciences ought to deal with the *quantifiable*, while literature revels in dealing with the *unquantifiable*. The former rely on *refutable* assumptions and procedures, while the latter is happy to rest on *undecidable* hypotheses. The former are expected to be *disciplined* and standardized in their operations, while the latter is valorized insofar as it is *creative* in the forms and procedures it mobilizes along its way. The scientific methods claim to be *objective*, insofar as they attempt to erase any personal interference generated by the singularity of their agents, while literary writing has no qualm about being *subjective*, insofar as it acknowledges the inescapable dependence of the results on the singular personality of the agent. As a consequence, the former have some legitimacy in pretending to reach some form of *universal necessity*, while the latter is limited to asserting *contingent singularities*.

More important for our present purpose than their content, their operational agents or their methods, the sciences can be opposed to literature in terms of their *MODES OF ABSTRACTION*. In the vocabulary popularized by Tim Ingold (2007), the sciences do their best to construct an "*above* perspective," whereby they consider facts and behaviors with distance and superiority, as if bending over a colony of ants. Literature, instead, tends to adopt an "*along* perspective," whereby the reader follows a certain path of life along the way experienced by the narrator-wayfarer. The benefits of the superior position reached by scientific abstraction come with a heavy price tag, however: they can only consider the workings of the ant colony one relevant parameter at a time. In a novel, conversely, a jealous passion can be mentioned alongside a certain financial interest, a change in the weather, a calumnious rumor, an unpleasant smell. While the scientific approach would start by dissecting the co-occurrence of these multifarious phenomena into different fields of investigation, each ruled by its specific method and discipline, literary narration or poetry confront us to their agglomeration into one single block of reality. Contrary to the sciences, literature performs analytic abstraction without enslaving itself to it.

This enslavement of the scientific approach to the fragmentation of the reality it studies will

appear more clearly in another contrast raised by their respective mode of abstraction. Even if they often fail fully to reach their ideal, the sciences attempt to maintain a level of *explicitness* that formalizes their measures and relevant parameters in *non-ambiguous* terms, whereas *implicitness*, polysemy and equivocity play a crucial role in our so-called "natural" languages, allowing literary writing to mobilize the potentialities of *ambiguous* expressions in order to help new perceptions and reflections emerge from our ever-changing relations with our environment. In other words: scientific investigation constrains itself to the (impossible) task of making fully explicit and unambiguous all the terms it uses to refer to the world (generally devising a systematically formalized language in order to do so more rigorously), while literary writing not only tolerates, but exploits as a vital resource the variable amount of implicitness, ambiguity and equivocity inherent to our natural languages.

To wrap up (provisionally) this rough opposition between literature and the sciences, one can refer to Roland Barthes's famous 1987 depiction of the odd structure of literary communication. While a play by Racine or a novel by Richardson seem to be making a series of positive assertions about the characters and situations they present to us, it is more accurate to read them as raising questions under the guise of providing answers. Hence a final contrast between the sciences and literature: whereas the goal of scientific inquiry is to provide *reliable answers*, the goal shared by literary writing and the humanities is to help us formulate *relevant questions*—i.e. public problems.

Should one look more closely at any of these massive traditional dichotomies, one would easily find exceptions, borderline cases and hybrid practices that blur such neat distinctions. As a matter of fact, rather than taking these terms of opposition as satisfactory criteria to separate scientific from literary activities, it would be much more interesting to hone in on these cracks and flaws, which is where "real" science and "real" literature actually take place, far from the clichés into which one tends to corner them. Taken as a whole and considered from a safe distance, however, this set of dichotomies can suffice to account for our common intuitions, as well as for the apparent oddity of witnessing, at different periods of our literary history (the 1880s and the 1970s, in the case of France), a "science of literature" emerge among the disciplines, while several forms of "scientific literature" have been around for quite a long time.

Computing as Ubiquitous Writing

The point I would like to make is that the emergence of computing machines, over the last seventy years, should lead us to acknowledge the collapse of some of the dichotomies evoked in the previous section, and the radical reconfiguration of others. Let us run the list quickly a second time, to see how often computers introduce a wedge into these traditional dichotomies. In the following pages, I will use the word "computer" to refer to what Alan Kay defined as a *meta-medium*, i.e. an electronic apparatus (potentially connected to sensors and networks) processing digitalized information with the capacity to simulate any other medium (see also Manovich 2013).

The oppositions of CONTENT—between, on one side, a referential effort, performed by mere observers attempting to produce an outer-oriented description of an exterior reality and, on the other side, fictional imaginers generating inner-oriented narrative events—find themselves deeply upset by the workings of our computers. As Vilém Flusser (1985) realized many decades ago, a radically new ontogenesis entered our world with the advent of what he then called "telematics" (i.e. the capacity to digitalize every type of information into binary bits, to store, compute, recombine and send them at will). The indexical nature of the chemical photographic image—which, as Lorraine Daston and Peter Gallison have shown (2010), played such a crucial role in the definition of scientific objectivity—is nowadays merely "simulated" by digital metamedia which rely on binary symbolic codes and software *ficta* (i.e., modelized and modelizing fictions) in order to detect, monitor, record and transmit "objective" *facta*.

In our digital world, a referential photography is no less reconfigured than the dinosaurs

resuscitated in the *Jurassic Park* film series: it too results from one possible Photoshop setting among many others. Whereas the analog camera, once it had been built, was bound to document the input in an indexical fashion, the computing metamedium is only *simulating* an indexical mode of representation, as one of its many possible settings (see Mitchell 1992). The same hardware could equally well be programmed to selectively erase certain forms, or substitute certain colors or sounds for other. As soon as they use the mediation of digital devices, Observers can only see through the eyes (i.e., screens) of Imaginers, inescapably introducing the fictional (i.e. a modelization) into the heart of the referential.

The apparatuses that (re)launched the adventure of scientific objectivity in the 19th and 20th century (cameras, microphones) drew their epistemological power from their ability to bypass human subjectivity and human intervention (see Kittler 1986). A purely physico-chemical process generated an imprint from the exposure of a certain portion of reality to a sensitive medium. This *analog* imprint was reputed and bound to be *iconic-indexical*, to recombine two of Peirce's famous categories. It consisted both in an imaginary resemblance (like all icons) and in a forensic evidence (like all indexes): something had *actually* been there, in front of the camera or the microphone, and it looked or sounded *like* that. Today's computing apparatuses, by contrast, unavoidably reintroduce the filter of human intervention and human subjectivity, since the programs that run the machines have been devised and designed by social and historical subjects (software programmers, who have been moved by sexual drives, motivated by ideological agendas or salaried by capital).

Or, to state this in a vocabulary more obviously relevant to discussing the relations between literature and the sciences: scientific equipment (in its apparatuses as well as in its epistemology) ingeniously attempted to have *Nature write itself* through the sensitive (but ideally "neutral") intermediary devices presented to her; computers can simulate such a neutral intermediation, with unprecedented degrees of accuracy and fidelity, but they necessarily *(re)introduce human writing* at the very core of the process of documentation (recording, monitoring, transmitting). During two centuries, the sciences have done their best to repress human ("subjective") writing in order to let us hear and see matter express itself: mechanical objectivity has written rules and generated devices capable of neutralizing the deformations inherent to the human activity of reading and writing. As a reaction to this victorious trend, literature, from Mallarmé to Woolf, and from Joyce to Rushdie, has staged the unchained freedom of human writing in its multifarious capacity to permeate matter with human meaning.

With the advent of ubiquitous computing, it becomes clear that writing intermediates *all* of our relations to our world—and, soon, to ourselves. This ubiquitous writing is both intensely human and never-merely-human, since it is massively machinic, automatized, inhumane, and sometimes de-humanizing (Kittler 1986). Literature—as the art of writing and of paying attention to the art of writing—is, quite literally, *everywae* (Greenfield 2005), even though it is indeed increasingly difficult to find it in its traditional human-centric guises.

Arts of Programming

In our common imaginaries, there is certainly a great distance between the Romantic poet drafting love verses under a tree, the devoted scientist mulling over data in her high-tech campus lab, and the software-designer (poorly) paid to devise new algorithms giving capitalism a firmer grip on our minds and behaviors. And yet, all of them are in the business of *programming*—a term considered here in accordance to its etymology: to "write ahead," to "write in advance," to "pre-scribe." The poet, the scientist and the software-designer all write (today) what will be done and thought (tomorrow) by their fellow-humans. What they are in the business of writing are not mere statements (matters of fact or matters of concern), nor even rules, as legislators do—but rather *protocols*.

As we learned from Alexander Galloway's classic book (2004), protocols—illustrated by the

TCP-IP standards that operate our access to the Internet—leave us free to receive and send any content as long as we respect certain formal and functional rules of syntax, playing a similar role to that of grammar in our common languages. The message conveyed by your sentence can be anarchist or royalist, but it will need to respect the formal rules of word positions and agreement in order to reach the understanding of your addressee.

What we learned from (French) theory in the 1960s and onwards is that literature does not merely produce messages: it reshapes the very protocols through which we communicate with each other. Similarly, science does not merely tell us whether our health is determined by our DNA or by our intestinal microbiote: it provides us with protocols helping us to investigate questions in order to reach reliable conclusions. Science, literature and coding: all three program us insofar as they constantly write the grammar through which we are led to account for our experiences, orient ourselves in them, react to them, and share our reactions with others. Galloway (2004) suggested that protocols are the way power imposes itself after decentralization. We could add that protocols and programs—i.e. written procedures which write ahead of time how we will write each other's fate—are what remains after the Great Divide between literature and science has been reconfigured into a triangulation with computation.

A suggestive polysemy positions the word *matrix* to encapsulate simultaneously the mathematical root, the economic productivity and the social effects of protocols. A matrix is a computational device, a rectangular array of numbers arranged in rows and columns, widely used in computer graphics. Its etymological root (*mater*, "mother") points to its cross-generative properties. As an abstract structure, a matrix can not only generate a wide variety of objects, depending on the data introduced in it: a matrix can also be multiplied by another matrix, combining two operations (a horizontal displacement and a folding upon itself) into one compounded transformation. It certainly is more than a coincidence if *The Matrix* (1999) provides the title for one of our most popular cinematic anxieties about the all-encompassing and totalitarian power of ubiquitous computing machines. The matrix literally appears as the computational womb out of which our relations with reality are generated, modulated and controlled through algorithmic recombination.

Our (perception of the) environment is structured as well as populated by forms of writing which are forms of matricing. The storyteller does not merely tell us about a sequence of events: she instills inside of us a narrative pattern (a matrix) which will prime our future expectations. A discoverer does not merely uncover a certain portion of reality: with each major discovery, she provides us with a new paradigm (a matrix) which alters and renews the way we understand, explain and experience reality. Much like the programmer does, the storyteller and the discoverer write formal protocols—matrices—which condition us a long way beyond the punctual CONTENT of what they write. This content still matters, of course. But computation helps us relocate agency at a higher level—that of matricing—which happens to be equally decisive for literature as for the sciences, but directly rooted in computing operations.

The OPERATIONAL AGENTS, when viewed under the light of such arts of programming, can be neither fully individual, since a grammar and a protocol gain traction only insofar as they are shared, nor merely collective, since the emergence of new forms of writing always sprouts from singular encounters and insistent idiosyncrasies. As Pierre Lévy (1992) and Anthony Masure (2017) have eloquently shown, the fine art of writing software brings together the reputedly contradictory characteristics of being technologically equipped (like the sciences) and artfully crafted (like literature). As for the METHODS involved in the arts of programming, they need to be both highly disciplined, since one small error in syntax can suffice to paralyze a giant machine, and highly creative, since a truly "elegant" solution to a strictly localized problem can pave the way for an unforeseeable range of unsuspected applications. Nowhere else than in the arts of programming mobilized by and around computing machines can one observe such a tight articulation between, on one side, the (supposedly

scientific) universal necessity of purely logical relations set into motion to generate a perfectly understandable course of action and, on the other side, the (supposedly literary) contingent writing of all-too-human individuals, who can be brilliantly or poorly inspired on the day they wrote any particular line of code.

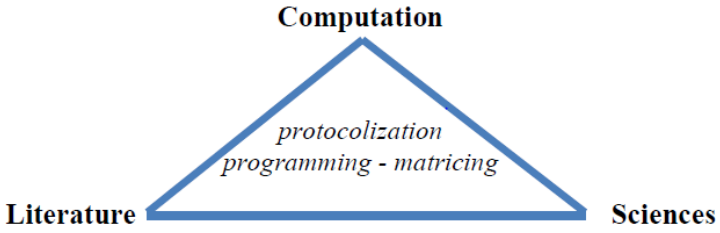

Figure 1: *First diagram of triangulation.*

What lesson can we draw from this first foray into the triangulation? The arts of programming developed by computation can be positioned as a third term which reveals the protocological nature of the work performed in the sciences as well as in literature. The content, the operational agents and the methods which were used to oppose both sides of the Great Divide seem overdetermined—and, up to a certain point, neutralized—by computation, insofar as ubiquitous computation immerses us in a world of ubiquitous writing, which hybridizes the supposedly incompatible features considered to be specific to each side, and exclusive of the other. In this version of the triangle, computing "absorbs" and rearticulates what the sciences and literature used to do separately. This first diagram of triangulation foregrounds the importance of the "meta-" level of writing illustrated by matrices and protocols: a writing which writes ahead ("pro-grams") how it will be (im)possible to write in the future.

Powers of Abstraction, Dangers of Extraction

This first diagram of triangulation discussed issues of content, operational agents and methods, but it left aside the contrast based on different *MODES OF ABSTRACTION*. Addressing these will generate a second diagram, significantly different from the previous one. The triumph of *everyware* computing is the triumph of abstraction. Everything, at any moment—we are told—is (about to be) digitalized and computed by algorithms. This digitalization is a form of abstraction. My shopping habits, my blood pressure, my communications with my friends, my cat's wanderings around my garden: all of these highly complex forms of material and mental behaviors are translated into sequences of 0 and 1, into data formatted by computing machines in order to be processed by computing machines. This massive enterprise of digitalization and computation continues, accelerates and industrializes a gesture that has been performed for half a millennium, on the artisanal level, by scientists in their laboratories—the gesture of extraction resulting in what we call abstraction. Since Galileo, Newton and Lavoisier, the sciences have progressed by *extracting* ever more precise *relevant figures* from their *environmental grounds*. These figures consisted both in objects of knowledge (a constellation, a chemical element, a bacterium) and in quantitative data (the speed of light, the frequency of a given sound wave).

This extraction of (quantifiable) figures from what previously appeared as a mere background gave Western modernity a truly amazing traction on the physical, biological and social world. The development of the technosciences, rooted in and fueled by this power of abstraction, has provided the cognitive means which, through the industrial revolution, have allowed Western nations and empires radically to reconfigure (and ravage) our physical, biological and social environments, pushing humankind into the Anthropocene. The sciences, literature and early forms of computation (like financial accounting) have each played their part in this progressive triumph of abstraction, which has both dramatically expanded human control over "nature" and folded it back on itself in countless

highly threatening and uncontrollable feedback loops.

Anthropologists like Anna Tsing (2015), political thinkers like Julie Graham and Katherine Gibson 2006), and environmental activists like Frédéric Neyrat (2019) jointly denounce the dangers and calamities generated by the extractivist attitude which has been the flip side of this triumph of abstraction. Western industrialists, in striking similarity to Western scientists, have (mis)treated our world as a mere supply of resources, reducing its entangled complexity to quantifiable figures (*assets*) that could be extracted from insignificant backgrounds. Extractivism mines our natural as well as social environments in search of profitable assets, which it extracts without bothering to ask how these resources were generated, nor how they can be renewed in a sustainable manner. Extractivism extracts the profitable figure without caring for the ground, hence undermining our perspectives of future well-being.

What does all this have to do with our triangulation between sciences, literature, and computation? Here again, as it was the case with writing and protocoling, computation brings in full light the far-reaching implications of the process of abstraction which was already at work within the operations performed by literature and the sciences. What is a poem, an essay, or a novel if not an extraction of meaningful figures from the (otherwise meaningless) background of a certain experience? What is scientific formula, spelled out after years of trials and errors in order to account for a certain physical, biological or social phenomenon, if not an extraction of meaningful figures from the puzzling backgrounds of nature and society? Both appear as a sequence of symbols (letters, numbers)— very similar and reducible to a sequence of 0s and 1s—abstracted from the multifarious entanglement of an infinitely complex relational situation, encapsulated into a matrix allowing us to understand and modulate future outcomes.

As we saw in the first section, however, there are a few crucial differences between the modes of abstraction practiced by literature and by the sciences. They are most strikingly expressed in Gilbert Simondon's 1958 book *On the Mode of Existence of Technical Objects*. In the last part of the book, Simondon presents the social function of the religious and of the esthetic experiences as connecting us to the ground out of which the technosciences have extracted their figures. Call it God, Allah, or Nature: all religions invite us to care for what remains after the profitable asset has been cleverly extracted, profitably exploited and individually enjoyed. Something lingers behind this punctual enjoyment, a background which is very difficult to identify, to name, to figure out—precisely because it consists in what is left *behind* what we can figure *out* of it. When Timothy Morton (2013) attempted to illustrate the category of "hyperobjects"—which, too, demand from us to identify a presence which is not perceptible as an isolable object—he did not turn to religions but to art works and esthetic experiences. The basic problem was similar, however: how does one establish a (caring) relation with the ground itself (the environment), when the inner structure of our perceptual habits obfuscates this ground, by focusing our attention on the extracted figures which blind us to what remains left behind?

This is where the difference between the modes of abstraction developed by literature and by the sciences become relevant. Abstracting from an *above* position, as the sciences attempt to do, or from an *along* position, as literature and the arts usually do, induces a significantly different attitude towards the environment. The wayfarer feels and touches the ground, while the balloon flyer merely maps it. The literary mode of abstraction generally acknowledges that it is situated within a sensory world of entangled relations, while the scientific mode of abstraction tries hard to extract itself from its living background (in the name of "objectivation").

A Fundamentalist Universe of Information, or a Livable World of Meanings?

More importantly, and more directly linked to the third player of the triangulation, the ideal of univocity which guides scientific discourse as well as analytic philosophy can be seen as a form of *figural fundamentalism*: only that which manages unambiguously to detach itself from its living

background will be accepted in the purified microcosm ruled by rigorous demonstration, formal proof and experimental refutability. Only pure figures can enter the debate, to confirm or refute other pure figures. The imperative of explicitness presupposes that "objects" can only be properly identified if they are unequivocally isolated—extracted—from their milieu. Here again, computing machines help us realize the full scope of such an imperative, both in the tremendous power of abstraction that it unleashes, and in the disquieting dangers of extraction that it materializes. The "artificial intelligence" developed in computing machines is both amazingly powerful, when it comes to sorting out billions of data in a millisecond, and pathetically dumb, when it comes to do something as basic as walking up a staircase. A verb as semantically simple a "to walk" makes sense to any human being, even if none of us is capable of explicitly delineating what it exactly entails to walk up a staircase. It is because their "natural" languages ignore figural fundamentalism that human intelligences manage to communicate with each other on a practical basis, i.e. in our lived world of objects undetachable from their background.

One error message commonly encountered in programing emblematizes the gap between these two modes of abstraction: *object reference not set to an instance of an object*. In literature and in the arts, as in our lived world, objects may be extracted from their original environment, but they remain connected to entanglements of entities which pre-exist any explicit definition we may attempt to provide about them. In the world of computing machines, one has to set an object as an instance of an object (in a procedure bound to obey a certain protocol) before a reference can be made to that object. Here is the epitome of figural fundamentalism: whatever has not been explicitly pro-grammed to be an instance of an object has no existence whatsoever. The computing world both functionalizes and radicalizes the ideal of explicitness that the sciences professed, but were never (and will never be) capable of fully enforcing.

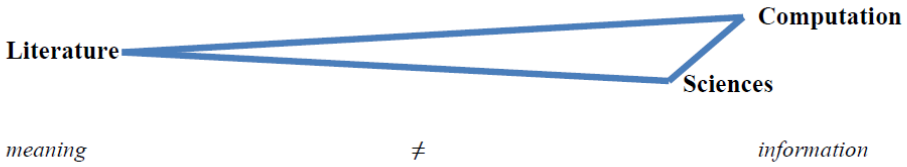

Figure 2: *Second diagram of triangulation.*

Our second diagram of triangulation looks quite different from the first one. Instead of computation bringing forth the commonalities between literature and the sciences, it now reveals *a limit* of the scientific endeavor (both in the sense of an asymptote and of a limitation), as well as *a virtue* of literary activities (both in the sense of a merit and of a power). The triumph of the computing abstraction projects us in an unlivable world, since this world requires objects to be explicitly pre-defined and programed before they can be referred to. Symmetrically, this second triangulation sheds light on the importance of being ambiguous (much more than of being earnest): implicitness and equivocity are a pre-condition for relating to the world in a livable (i.e., in a non-fundamentalist) manner. We need literature and the arts, literary studies and the humanities, to make our world of ubiquitous computing livable, thanks to the flexibility introduced, maintained and nurtured by an art of writing that takes polysemy as a challenge, an ally, an opportunity, and a source of inspiration, rather than as an enemy to eradicate.

In order to tie together two claims made separately in the previous paragraphs, one could suggest that the care for the background attributed by Simondon to religious and aesthetic approaches constitutes the other side of the tolerance and inclination towards equivocity. Ambiguous statements

need contextual reference in order to make sense: their figures maintain a certain dependency towards the environment and the background out of which they were abstracted. Literary enunciation simultaneously abstracts itself from its contextual origins (contrary to non-literary statements like "You owe me ten bucks") and assumes its anchorage within situated and situating backgrounds. Literary enunciation acknowledges that one always says more (implicitly) than one knows (explicitly). It is this exceeding of what is tacitly conveyed over what is explicitly intended that connects our statements, as well as our knowledge, to our social and natural surroundings.

Retrospectively, the mechanical demands of computational programing reveal the extremism of the (dominant) scientific epistemology (and its twin brother, analytical philosophy). One way to account for this extremist proximity between computing machines and the sciences would be to project the gap that separates them from the literary attitude on a polarity opposing a universe of information to a world of meanings. Computing machines allow us to redefine *information* as that support of knowledge (*data*) which can circulate (be stored, transmitted, processed) within electro-magnetic circuitry. Our computers, servers, hard drives and USB keys are full of information, which algorithms can sort out and recombine in countless manners, according to countless goals. Information technology, in the digital era, is only a matter of electricity—strictly physical. Information is only endowed with *meaning* once some form of human attention invests its bodily (analog) energy into it. It takes flesh for information to make *sense*.

Beyond the piles of books and articles devoted analytically to distinguish "meaning" from "sense," I use both terms indifferently within the scope of this article, insofar as both presuppose something more than mere information. Namely: the capacity pragmatically to apply and adjust a set of instructions and data to a singular environment of action, as an affective response to a socially-constructed but individually-felt situation. Such a definition of meaning/sense is not to be limited to the "propositional content" or "message" of intentional act of communication between humans. My caresses probably have meaning and sense for my cat. The greater part of our literary experiences is carried under, above or beyond what an author may have intentionally meant to convey to her readers, under, above or beyond what our explicit reasons can identify as the purpose(s) of our actions. It takes flesh for information to make sense, because it takes a living body for affects to process and express a "felt reality of relation" (Massumi 2002, 16). Compared to the intents, goals and purposes we can be aware of, meaning is fundamentally *open-ended*, insofar as a feeling comes prior to the reaction a relation may generate in us. Meaning and sense are rich with the "pre-acceleration" that emerges in (animal) moving bodies before they even start to move, from the simple fact that they always-already belong to certain relations (see Manning 2009). Computing machines concretely display the fully achieved abstraction of information reduced to purely electric differentials (0s and 1s), thus accomplishing the ideal of objectivity, necessity, explicitness and universality the sciences have dreamed about over the last four centuries. Conversely, the dumbness and senseless nature of computing machines reveal the extent and importance of the fleshing out of information into meaning, performed every time an animal body makes a physical or mental movement. By doing so, computing machines set the parameters for what ought to be the most extensive ground of action opened for literature by the advent of ubiquitous computing: *there is room (and there is need) for literary work to be done each time information is in want of meaning and sense*. (Hence my apparently mad claim that anything undergraduate students can consider as enjoyable will be considered literary by my standards.)

Writing Programs Against the Programs

Coming from a professor in literature, this second diagram of triangulation—which portrays literature as a potential savior against the dangers of an extractivist attitude pushed to a fundamentalist extremism by scientists and computers alike—can legitimately be suspected to reek of shameful corporatism. It would obviously be ridiculous to fall back on the worn-out cliché opposing a soulless

technoscience to a humanist conscience. Biologists and climate scientists are much more active, visible and efficient than poets and novelists at the forefront of our current ecological struggles. Hackers[2] have denounced and fought against totalitarian computation much more inspiringly than literary scholars. We therefore need to complement our triangulation with a third diagram, in order to show how literature, the sciences and the arts of programing can converge and set up new alliances in overcoming the dangers of our digital age.

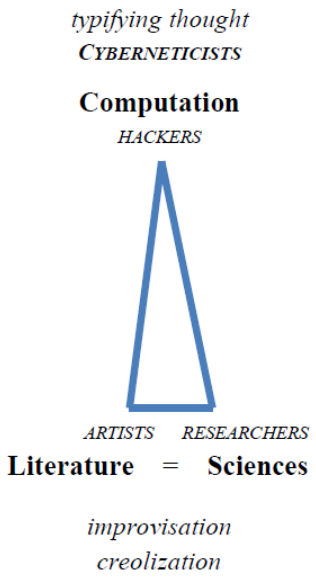

Figure 3: *Third diagram of triangulation.*

Practitioners of literature (and, more generally, artists), scientists, as well as hackers, can indeed all be enrolled under a common banner, whenever they operate as *writers of programs that paradoxically attempt to overcome the limitations inherent to (pre-existing forms of) programing*. Adopting such a view would suggest, however, that the sciences may be on the verge of experiencing a split that has affected the literary domain for quite a while. One has long ago ceased to expect novelists, poets, playwrights and literary critics to provide us with answers to the burning questions of the day: their role is rather to question our current responses and solutions, not to provide better or definitive ones. Scientists, by contrast, are still often expected to function as authoritative sources of answers to tackle the problems faced by our societies. This expectation may wane in the decades ahead, just like it progressively waned for literary writers and critics during the 20th century. As the figure of the "information processor"—once devoted to the *clerc* and the *lettré*, then delegated to the *savant* and the scientist—tends to be mechanized and automatized in our computing machines, the function of the scientist will have to redefine itself along displaced lines. And this process is likely to bring about new parallels between artists, scientists and hackers.

All three categories deserve to be resituated and reconsidered within the new mode of algorithmic governance identified for half a century with the rise of cybernetics. The *Cyberneticist*—i.e., the expert in information science capable of writing programs likely to provide trustable answers by sorting out relevant data and developing relevant algorithms—becomes the default figure of dominant knowledge, enthroned at the summit of our triangle. Positioned in contradistinction to the cyberneticist, artists,

[2] What I will call *hackers* in the following pages refers not only to code-breakers but, more widely, to all "abstracters of information" (McKenzie Wark 2004, NEED PAGE NUMBER) who develop a *tactical* use of digital media, defined as "those phenomena that are able to exploit flaws in protocological and proprietary command and control, not to destroy technology, but to sculpt protocol and make it better suited to people's real desires" (Galloway 2004, 176).

scientists and hackers can find new common grounds. Just like artistic writing attempts to throw a gestural wrench into the automatic course of programmed perceptions and values, just like hackers attempt to free the flows of information where they are unduly enclosed by exploitative rules of property or by oppressive surveillance, in a similar way, scientific research, in the age of self-learning algorithms, is called upon to supplement the automated processes of programmed investigation with a surplus-value proper to human imagination and judgement (Huyghe 2017; Montani 2018). Artists play the nuances and engagement of human gestures against the rigidities of the programs (Citton 2015); hackers exploit network vulnerabilities to resist the hegemonic modalities of social control (Galloway and Thacker, 2007); scientists amend and improve the workings of computing machines thanks to the dephasing, rescaling and reorienting allowed by human reflection.

Within this third diagram, the common cause shared by the three categories of operators consists in *writing programs and protocols which help our living gestures push the boundaries of the programs and protocols they run into*. In resistance to—while not necessarily in open conflict against—the cyberneticist's ceaseless attempt to "optimize" programs and protocols, artists, scientists and hackers tend to develop improvisational skills and creolizing tastes. *Improvisation*, as its etymology suggests, puts us in a position where what was programed—pre-scribed, pre-dicted, pre-meditated, pre-mediated (fore-seen: *pro-visum*)—does not suffice fully to determine how one is to behave. A weak conception of improvisation claims that we improvise all the time (I usually start a sentence without having a fully clear idea of how I will end it). A more demanding, and more interesting, conception of improvisation hones in on procedures whereby one establishes "enabling constraints" (Manning & Massumi 2014 NEED PAGE NUMBER) that will push us creatively to imagine or generate the unimaginable. Along a parallel line of thought, Edouard Glissant has defined *creolization*—by contrast with "hybridization," wherein a mix of previously separated elements bring about a predictable outcome—as the purposeful or chance-driven coming together of bits and pieces originated from different traditions, insofar as it leads to the "emergence of something new and totally unforeseeable" (Glissant 1997; see also Nova & Vacheron 2015). The main result of our triangulation may be to help us identify improvisation and creolization as key features of a common endeavor to write programs against the programs shared—an endeavor shared by artists, scientists and hackers alike.

Open Ends

Such a reconfiguration of the intellectual landscape was strikingly anticipated, as early as the 1970s, by the nomadic media theorist Vilém Flusser (1920-1991). Across his publications, he presents the constitutive tension between embodied gestures and automated programing as the crucial dynamic likely to animate the development of the arts and the sciences in the future. Flusser's analysis of the evolution of writing characterizes the progressively unleashed power of printing as leading to the current hegemony of *typing*, understood as "the production of types." As direct heirs to the writers of the Gutenberg era, IT specialists pursue the job of "unfurling the typifying mode of thought in all areas of culture. This consists in finding types suited to distinctive features of the world, in continually improving them, and in then impressing them on the world" (Flusser 1987, 52). In other words, more familiar to what the previous sections of this article have suggested, our commercially-run computational world is based on the extraction of typified figures, which impose models to our senses and practices, often at the cost of what remains ignored in the background from which such modelizing figures have been abstracted (see also Abram 1999).

As we have seen, we can no longer escape the hard truth that this "victory of typifying thought" comes with a heavy price tag: "for progress—of science, technology, economics and politics—from the concrete objects to an abstract type is slowly but surely revealing itself to be destructive madness, for example, in Auschwitz, in thermonuclear armaments, in environmental pollution, in short in the apparatuses that typify and universalize everything" (ibid.). The ubiquitous medialization brought

about by the printing press, telegraph, telephone, cinema, radio, television and the Internet has immersed us in a world where *media* (to be understood in their etymological root of "means") function *through* us, at least as much as *for* us: "decision-making centers have become automated. They intersect with one another in complex ways and the decisions can no longer be grasped politically; rather they function on the basis of other functions of apparatus" (Flusser 1987, 115). As a consequence, "the means have become so clever that they make the ends superfluous. They become their own purpose. Means becoming their own ends and ends becoming superfluous: this is what is meant by 'media culture'" (Flusser 1987, 131). Types blind us to both nuances and backgrounds, entrapping us in (self-)destructive modes of extraction bound to follow what has been programed (as means for profit), instead of developing our attention to potential opportunities of more desirable ends.

In the cyberneticist's world ruled through and through by the "victory of typifying thought," traditional forms of critique lose their traction—a partial explanation for the loss of prestige and agency enjoyed by literary studies and the humanities at large. According to Flusser, this waning of critique is due to the obsolete enduring of linear modes of causal explanation and to the understanding of critique as geared towards the substitution of old (inappropriate) types with new (improved) types. We must realize instead that our digital world, bathed in technical images and sounds, is ruled by post-linear forms of causality, as much as it is in need of post-typifying gestures. It is revealing that Flusser would situate the invention of this new ("post-critical," "post-historical") mode of research at the *meta-* level characteristic of protocological valuation and writing: "A completely different critical method is required, one that is only approximately named by the concept of 'system analysis'" (Flusser 1987, 152).

Contemporary artists, hackers and scientists alike share a common function in our "media culture" geared by the cyberneticist governance towards the automated growth of purposeless means. All three labor in a form of "system analysis," insofar as they attempt to introduce meaningful variations into the mechanical reproduction of "types." All three challenge the flows and the management of information by raising questions of meaning and sense, and not only of optimization. All three work on points of tension between the gestural body, immersed in the media culture, and the computing machines that surround and permeate our world with their unleashed power of (re)calculation: "Now that numbers are beginning to liberate themselves from the pressure of letters, and computing is being mechanized, their visionary power can unfold: [...] science presents itself as an art form and art as a source of scientific knowledge" (Flusser 1987, 28-29).

This article, which is now reaching its conclusion, can be read as an *explication de texte* of this last quote. The (by now rather common) claim that "science presents itself as an art form and art as a source of scientific knowledge" cannot be understood in its wider anthropological stakes outside of the triangulation operated between the arts and the sciences by the rise of computing machines. Flusser's philosophy—alongside the works of Friedrich Kittler, Wolfgang Ernst, Siegfried Zielinski, Jussi Parikka, Thierry Bardini and other practitioners of media archaeology (see Parikka 2012 and Citton 2019)—provides us with a most inspiring way to conceive such a triangulation, in its multiple possible diagrams. The fact that it emerged almost half a century ago should makes us wary of any claim of absolute novelty accompanying this reconfiguration of the relations between literature and the sciences.

Judging from the dramatic shrinkage of job offers in the Humanities on both sides of the Atlantic, literary studies may seem desperate to devise a renewed agenda, and the type of new transdisciplinary articulation sketched by this triangulation fits the needs too closely not to sound suspect. Beyond a corporatist *pro domo* argument for the survival of the Humanities, the perspective promoted in the preceding pages may also be of interest for scientists potentially worried by the commercial pressures which, under the guise of "disruption," tend to ensconce scientific research in the deceptive comfort of business-as-usual—while it becomes increasingly clear that the capitalist business-as-usual will not be capable of optimizing itself out of its current ecocidal and egocidal trajectory. The call for triangulation will not be resorbed by a (hypothetical and improbable) revival of the academic institutions which have

so far supported the teaching and practice of literature. Telling students that whatever brings them enjoyment will pass for a literary experience is a shorthand for a much broader claim.

In a fundamentalist universe of information saturated with ceaselessly optimized means, the sheer emergence of an autotelic activity—an activity that finds its end (*telos*) nowhere else than in its own accomplishment—may constitute the most radical, as well as the most innocent and contagious swerve away from the business-as-usual of financial capitalism. Human practices draw their intelligence from the rudder provided by their sensitivity to pains and pleasures. The most advance IA remains as dumb as a rock as long as it is not irrigated by the drives of human hopes and fears. Endowed with the amazing power of computing devices ruled by the no-less-amazing power of the capitalist machine, artists, hackers and scientists are equally threatened to see their desires and their anxieties trapped within the pre-programed ends of financial profit. Our deepest challenge is to devise "complex emergent processes rather than programmed organizations" (Manning & Massumi 2014, 93). Our ends need to be significantly more open than what is currently tolerated by the current regime of financial capitalism. Our environments will continue to provide us with a livable world of meanings only insofar as we reflect and act upon the emergence of ends located in life itself—rather than in its exploitation.

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