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On the Limit of Artificial Intelligence

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Abstract: This article asks how can we articulate the limit of artificial intelligence, which virtually has no limit? Or maybe the definition of AI already implies its limit, how Marvin Minsky once declared that there is no generally accepted theory of intelligence, and that AI is only one particular way of modelling it. This article revisits the debate between Minsky and Hubert Dreyfus and repositions them in terms of an opposition between mechanism and organism, in order to expose the limit of Dreyfus's Heideggerian critique. It suggests reflecting on the relation between noodiversity and technodiversity to methodologically broaden the concept of intelligence, and on how different concepts of intelligence could be thought by introducing the Chinese philosopher Mou Zongsan's interpretation of Kant's intellectual intuition.

Key words: artificial intelligence, cybernetics, intellectual intuition, Kant, Mou Zongsan, Heidegger, Dreyfus

There is, of course, no generally accepted theory of "intelligence";
the analysis is our own and may be controversial.
—Marvin Minsky, Steps Toward Artificial Intelligence *(1961)*

We must add that the body, now larger, calls for a bigger soul,
and that mechanism should mean mysticism.
—Henry Bergson, The Two Sources of Morality and Religion *(1932)*

§1. The Paradox of Intelligence

The title of this essay is "On the Limit of Artificial Intelligence," which immediately implies a question: in what way can one talk about the limit of such a thing, given that intelligence, as long as it is artificial, is more susceptible to mutation than human intelligence whose mechanism is still beyond comprehension? Or in other words, how can we talk about the

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limit of something that virtually has no limit? The artificiality of intelligence is fundamentally schematized matter. However, it has the tendency to liberate itself from the constrains of matter by acting against it in order to schematize itself. Henri Bergson distinguishes intelligence from instinct, for only the former is able to produce tools and tools that produce tools, therefore the human is first of all *homo faber* before being *homo sapiens*;[1] Bergson then correlates intelligence with matter, and suggests that the development of intelligence is fundamentally a geometrization of matter.

This definition of intelligence and its development create a tension in Bergson's philosophy of life. On the one hand, Bergson wants to overcome this geometrism—which may also be considered mechanism or mechanicism—by returning to a philosophy of life pivoted on the notion of élan vital, as he similarly did with an opposition between abstract space and real duration. Élan vital distinguishes organism from mechanism, since the latter wants to explain life without life, and therefore ignores the ground from which life emerges. Élan vital is not something that can be objectified and reified; it is a creative force that makes possible the exteriorization of the intelligence in terms of tools and the interiorization of tools as organs. Intelligence, through the invention of tools, allows the complexification of the organism by adding to it exteriorized organs. On the other hand, through geometrization (i.e., a strict form of schematization), intelligence being exteriorized, though temporarily confined to matter, also liberates itself from matter, or more precisely, it enables itself to be transferred from one matter to another—a modern form of transubstantiation. This gives artificial intelligence the capacity to produce faster and vaster mutations than human intelligence, a fact that Bergson also recognized.[2]

We may find here a paradox of intelligence. In so far as intelligence constantly exteriorizes itself in order to interiorize its own products, as in what Hegel calls the cunning of reason, at a given moment it may fail to reintegrate its exteriorization, and end up being threatened by and subordinated to its own products—thus the "unhappy consciousness" that we witness today concerning panics of mass unemployment, the defeat of the human, and consequently the re-emergence of reactionary politics. It seems almost evident to us today that in the long run, machine intelligence will supersede every *quantifiable* function of human intelligence, and challenge the notion of élan vital attributed to organic life, as it had already begun to do in cybernetics in the twentieth century.

"On the limit of artificial intelligence" does not refer to the weaknesses of machine intelligence: what it could not do, still cannot do and will never be able to do. Machines are part of the process of evolution of the human species, if we understand that a technical life persisted from the australanthropians (zinjanthropes) to the neanthropians (*homo sapiens*). The technical form is a central aspect of this lineage, which human beings were able to control but over which

they are on the verge of losing control. This instability gives rise to the fantasy of the *homo deus*, which sees the destiny of human intelligence being superseded and conquered by machine intelligence which virtually has no limit. However, to expose the limit of artificial intelligence is not to render machines weak again, but rather to liberate machine intelligence from the bias of certain notions of intelligence, and therefore, to conceive new political ecologies and political economies of machine intelligence—a thesis that we will have to elaborate elsewhere. To expose the limit of machine intelligence, we will have to understand its history and that which motivates and constrains its evolution. One often fails to understand that the technical reality—a term used by Gilbert Simondon—inscribes in itself also the human reality, not only because technology is the realization of the mental schemes conceived by the designers and engineers, influenced by social and political structures of the human society, but also because the technical reality equally transforms the human reality. Human society is transformed by technical inventions and such transformation always exceeds the anticipation of the mental schemes. Matter and spirit form a reciprocal relation, there is no materialism without spirit, and there is no spiritualism without matter. Any failure to recognize this reciprocal relation only leads to its self-defeat.

Technical evolution is motivated by epistemological ruptures, through which its principles of operation undergo revolution. The rupture we want to focus on here is the shift of machine intelligence from a linear mechanical inference to a recursive digital operation. The term recursion has several nuanced meanings, but for the moment, let us understand it in terms of "reflexivity." This shift conceals the mysterious power of machines, which we are still far from appropriating and appreciating. In *Recursivity and Contingency*, I have attempted to recount this history of evolution of machine intelligence as a transition from Cartesianism to organicism.[3] The mechanization and rationalization intrinsic to Cartesianism in the seventeenth and eighteenth centuries is best captured by the image of a clock. Inside a clock, the cause and effect are enchained by physical contacts between different parts. This linear intelligence—materialized in gears and pulleys—gave us automata like Jacques Vaucanson's digesting duck, and also later automatic machines in the factories of Manchester in the nineteenth century described by Karl Marx. However, this epistemological paradigm generalized as a mechanical world picture foregrounds scientific research and economic analysis, for example in Newtonian classical physics, as well as in Marx's analysis of capital, which is basically a description of the operation of a mechanical machine. The epistemological rupture after mechanism presents and imposes a different paradigm and therefore a re-evaluation and re-grounding of all disciplines already shaped by the previous paradigm. The emergence and elaboration of a new causality in the twentieth century, which we call recursivity, provides an overarching ground for a series of new ideas, including cybernetics, systems theory, complexity theory

and ecology, among other disciplines that function according to a non-linear form of reasoning.

§2. Cybernetics and Intelligence

This non-linear reasoning liberates machine intelligence from confinement to the linear causality of Cartesianism, and challenges the duality that grounds the mode of criticism since the eighteenth century, namely the irreducible differences between mechanism and organism. This was the main thesis of early cybernetics: the founder of cybernetics, Norbert Wiener, mobilizes advancement in physics, especially statistical mechanics and quantum mechanics, claiming that it is possible to employ the two notions of feedback and information to construct a cybernetic machine that breaks the boundary between mechanism and vitalism.[4] Wiener thus concludes that "The modern automation exists in the same sort of Bergsonian time as the living organism, and here there is no reason in Bergson's considerations why the essential mode of functioning of the living organism should not be the same as that of the automation of this type. . . . In fact, the whole mechanist-vitalist controversy has been relegated to the limbo of badly posed questions."[5] Or, in other words, Wiener is claiming that a Bergsonian machine is possible.

Retrospectively, we may say, in a superficial way, that Wiener echoed and realized Bergson's proposal in *Creative Evolution*, namely, "to make a machine which should triumph over mechanism."[6] We may also want to call this idea a "digital vitalism," which would be a new offspring of computationalism. We should equally recognize that in fact Wiener did not really get Bergson right, because first of all vitalism is not exactly organism.[7] In the first chapter of *The Two Sources of Morality and Religion*, Bergson makes this rather clear: organism is still bound by inexorable laws. For example, any part is conditioned by the other parts and the whole, and vitalism emphasizes free will, which constantly resists the tendency towards a closed society.[8] Therefore, we cannot fully affirm that Wiener has overcome the duality between mechanism and vitalism; we can at most recognize that Wiener has discovered a technical operation, which is able to assimilate the behavior of organisms. The model and its technical realization that Wiener proposed have a significant impact in the conceptualization and modeling of intelligence. As we know whenever artificial neural networks are invoked, we are often reminded of the work of Warren McCulloch and Walter Pitts, the two researchers who joined Wiener's Macy Conferences during the 1940s. McCulloch and Pitts provided the first model of the neural network based on cybernetic principles.[9] In McCulloch and Pitts' account, brain activity could be seen as logical operations made possible by neurons. Neurons are both memory and logical operators, which recursively update their individual states and the overall result. In short, cybernetics is also

our point of departure, as well as the point of view through which we can analyze our actual situation.

This account of history is seemingly distinct from the standard story regarding the origin of the term artificial intelligence, which is said to have started with the Dartmouth conference in 1956, associated with scientists and researchers like Marvin Minsky, John McCarthy and Claude Shannon. According to the standard account, the conference was followed by a further development from weak, symbolic AI (or what John Haugeland calls Good Old-Fashioned Artificial Intelligence) to strong AI, and finally arrives at today's fantasy of super-intelligence. This standard story unfortunately prevents us from seeing the epistemological rupture between organism and mechanism which was already pronounced by Immanuel Kant in the *Critique of Judgement*, and which was later realized in cybernetics. In the *Critique of Judgement*, Kant develops what he calls "reflective judgement" to describe an operation that does not follow pre-given rules. Unlike "determinative judgment," which applies the universal to the particular, "reflective judgement" starts from the particular to arrive at the universal following the heuristics of the regulative principle. Namely, it derives its own rules in the process of moving towards a *finality*. This *telos* is not given in advance as objective fact and standard, for example, the end of nature, the beautiful, or autonomy. We cannot give a standard of the beautiful, since it will immediately confront its negation. When one says that the work of Paul Cézanne is beautiful, the person next to you may disagree, and one easily arrives at the conclusion that the beautiful is socially constructed or a matter of taste (which in turn is a question of class). However, the beautiful is not merely subjective, since if so, it would be contingent. The beautiful in the Kantian sense is what we might call *subjectively objective*, meaning that its existence cannot be comprehended as an object, however, in so far as it is necessary and universal, it can be known through the subject. It is only through reflective judgement that we can arrive at the idea of the beautiful. This is why, in an article titled "Epistemology and Cybernetics," Gilbert Simondon claims that it is only in the *Critique of Judgement* that Kant was able to deal with cybernetics.[10] He makes this claim because reflective judgement bears a certain affinity to the notion of feedback and because its teleology is therefore not an inevitability.

The recursive form is much more powerful than the mechanistic form. The recursive form allows the algorithm to effectively absorb contingency to improve computational efficiency. Intelligence emerges when it is no longer mechanical, meaning that it is able to deal with accidents, which are not inscribed within the rules. For example, when an amplifier is purely mechanistic, it will amplify every incoming sound, including noise; while an amplifier with noise reducing function implemented with a machine learning algorithm, will be able to distinguish noise from desirable sound. In an everyday sense, we will say that the latter is more "intelligent" than the former. Recursivity, which we mentioned above as a

new epistemology, is based on an organismic mode of thinking, since it is possible to derive its own rules from empirical facts instead of depending on hardcoded rules: it does not simply apply the universal to the particular.

The opposition between mechanism and organism is embedded in modern philosophy, and serves as the ground on which new concepts were developed to flee the enslavement of Cartesian mechanism. This negation (of mechanism) could be seen as a generalized tendency of thought, however it seems to have come to an impasse. In a recent book by the philosopher Catherine Malabou, *Morphing Intelligence*, she admitted her mistake of opposing brain plasticity (based on a synthetic reading of Hegel's organicism and modern neuroscience) to machine intelligence in her earlier work, writing: "I was indeed mistaken in *What Should We Do with Our Brain*?: plasticity is not, as I argued then, the opposite of the machine, the determining element that stops us from equating the brain with a computer."[11] What Malabou says is true in so far as a contemporary digital machine no longer resembles eighteenth-century mechanism, as many philosophers still believe today; rather it is recursive, employing a non-linear causality to arrive at a *telos*, like the behaviour of organisms. I nevertheless believe that Malabou's claim of "equating the brain with a computer" does not yet move far enough away from Wiener's claim, made seventy years ago, and this means that philosophy has to become "more reflective" than it used to be! "More reflective" does not only mean paying more attention to machines, but also implies having the capacity for philosophy to reinvent itself in order to *resituate* cybernetics, just as Kant did for mechanism in the third *Critique*.

When one looks into the development from weak AI to strong AI, one sees that it further extends the recursive thinking of cybernetics. Weak AI, though based on recursive machines such as the universal Turing machine, was not yet able to comprehend the recursivity between cognition and the world. It ignored the fact that cognition is embedded in a world and also embodies it, and therefore that intelligence has to be understood as a recursive operation between cognition and the world, which constantly modifies the structure resulting from their coupling. We can see that recursion is a thinking which can take place on *multiple orders of magnitude*, for example, the Turing machine or Kurt Gödel's general recursive function on one order, and the structural coupling between the artificial intelligence simulated by the Turing machine and the world outside of it on the other.

Cybernetics with digital recursive machines characterizes a turning point in history, in which machine intelligence exceeds the stereotypical soulless automaton described by Descartes. The circular causality implemented in machines seems to suggest a movement analogical to the soul: the soul is that which returns to itself in order to determine itself. For the Greeks, especially Aristotle, notably Book III of his *De Anima*, thinking or reasoning (*noien*) is a process in which the I of reasoning recursively transcends both the I of perceiving and imagining, so that

the errors of imagination and perception could be examined and corrected and the intelligence can remain unaffected. Cicero rendered *noiesis* into *intelligentia* in Latin, *inter-* meaning between, *lego*, meaning to collect and to choose, and finally to read, namely the capacity to understand and recognize. Invoking the Stoics, in *De Natura Deorum* Cicero also mobilizes *intelligentia* and the faculty of language to distinguish human beings from animals. Like the gods, human beings have reason, while animals do not.[12]

This circularity characteristic of the soul was not explicitly thematized in Western philosophy, remaining implicit until the post-Kantian idealists. German idealism could be seen as an attempt to rearticulate the "I think" in terms of both its conditions of possibilities and operational models. As an antidote to the Cartesian linear and mechanical *I*, a recursive *I* is posited as the condition of reasoning. The German Hegelian and Cybernetician, Gotthard Günther, sees that cybernetics is a step towards the construction of the consciousness of machines, and the implementation of the Hegelian reflective logic.[13] Günther understands the evolution of machines as a progress toward Hegelian logic: A classical machine is a *Reflexion in anderes*, a von Neumann machine is a *Reflexion in sich*, but a "brain machine" is a *Reflexion in sich der Reflexion in sich und anderes*," as "Hegel says in the greater Logic."[14] This is what distinguishes a digital computational machine from the old mechanism of Descartes, and in this formulation we see a very close, if not an identical, relation between philosophy and technology. If Wiener's cybernetics overcomes the critique of Bergson—or rather realizes what Bergson dreamt of inventing in *The Two Sources of Morality and Religion*, "machines which triumph over mechanism"—Wiener still fails to recognize the paradox of intelligence, at least until his later work, "Some Moral and Technical Consequences of Automation," published in 1960, three years before his death.

§3. World and Intelligence

In the 1970s American philosopher Hubert Dreyfus published a series of writings on the limits of Artificial Intelligence, notably his 1972 book *What Computers Cannot Do? A Critique of Artificial Reason*, accusing AI scientists, especially Marvin Minsky, of limiting cognition to a "particular, knowledge or model structure."[15] For Dreyfus, the ontological assumption of cognition in the early AI research is fundamentally Cartesian. Or, in the words of Heidegger, the Cartesian intelligence sees an object in front of it simply as *Vorhanden* (present at hand), that which is against the subject and has to be contemplated as a bearer of properties. By contrast, Dreyfus suggests we conceive an embodied cognition that corresponds to what Heidegger called *Zuhanden* (ready to hand), meaning that the thing in front of me does not appear simply as a bearer of properties, but rather its mode of being is conditioned by the world. Being-in-the-world could

be conceived as a temporal and relational constellation, which couples the cognition and the object of encounter. For example, in the case of using a hammer, we do not contemplate the shape and colour of the hammer, since the world, which could be presented as a matrix of relations (*Bezugszusammenhang*) or the totality of references (*Verweisungsganzheit*), is already embedded in cognition.

> Even a chair is not understandable in terms of any set of facts or "elements of knowledge." To recognize an object as a chair, for example, means to understand its relation to other objects and to human beings. This involves a whole context of human activity of which the shape of our body, the institution of furniture, the inevitability of fatigue, constitute only a small part. In assuming that what is given are facts at all, Minsky is simply echoing a view which has been developing since Plato and has now become so ingrained as to seem self-evident.[16]

From the point of view of logic, Dreyfus's critique of "artificial reason" could be interpreted as a critique of the employment of linear and mechanistic thinking instead of recursive and organic thinking to model cognition. He therefore concludes that the impasse of AI is also the impasse of Western metaphysics, countering that Heideggerian thought—an attempt to go beyond metaphysics—provides an alternative, with which one might conceive a Heideggerian AI.[17] Though the identification of weak AI with the history of philosophy from Plato to Leibniz at times seems to lack finesse, Dreyfus has nonetheless pointed out that one has to look into the ontological, epistemological and psychological assumptions of computation, and question their limits and legitimacy. Dreyfus's analysis has influenced computer scientists such as Terry Winograd and Philip E. Agre, among others. More recently Brian Cantwell Smith, who probably came to Heidegger through John Haugeland, has reformulated Dreyfus's thesis in his own terms as "reckoning" and "judging."[18] Though Cantwell Smith addresses a vastly more updated technological condition than did Dreyfus, the critical apparatus is shared.

Here we propose that, after Dreyfus, we will have to re-read §17 and §18 of *Being and Time*, which inspired Dreyfus's critique against the good old-fashioned AI. When I say *re-read*, it means that we should go beyond what Heidegger intended to say in view of what is happening in our time, not only because it was written in 1927, when AI was still absent, but also because the philosophical concepts have to be rethought.[19] §17 and §18 are respectively titled "Reference and signs" and "Involvement and significance: the worldhood of the world." Here, Heidegger lays down the ontological foundation for the analysis of tools and signs, namely references (*Verweisungen*), and how involvement (*Bewandtnis*) conditions the structure of references, e.g., the encounter between the tool and the human *Dasein*.

From the outset, the world that Heidegger describes is the other of cognition and irreducible to cognition, since cognition is made possible by the world. The world and cognitive content could be seen in terms of relation between ground

and figure in Gestalt theory. The world is constituted by a complex totality of references, and cognition depends on these references in order to reason. Or in other words, cognition is part of the world, as part to the whole. However, and this will also be the key for the re-interpretation of §17 and §18 of *Being and Time*, the world is changing, since it is *no longer* the phenomenological world that Heidegger was describing. The world is increasingly captured and reconstructed by mobile devices and sensors. This is the process of digitization and digitalization. The world is largely locked on screens, especially considering that today people can virtually do everything with Apps on their mobile phones. The strength of platforms is that they constitute a world purely based on data, which can be accumulated, analysed and modelled. With the increase in the amount of data and the improved mathematical models being developed, machines can achieve higher precision in terms of prediction.

When the world is becoming a technical system, so to speak, the world that Heidegger describes as the ground of truth—in the sense of *a-letheia*—is reduced to sets of data which are logically analysable and arithmetically calculable: *mathesis universalis*. The world ceases to be incalculable; in other words, it ceases to be the ground in the epistemology based on computation. This is also why, today, we think that artificial intelligence is becoming more and more powerful, and the question of the world emphasized by both Heidegger and Dreyfus becomes less and less significant, because we are living in a digitalized world, a world of the *Gestell*. The powerfulness of artificial intelligence is based on the reduction of the world to computational models. This seems to be a typical critique against reductionism; however, the story is not so simple. It is not that reductionism is bad, but rather that it is bad when it is considered as the totality of reality, which was once the fault of Cartesian mechanism.

This is what we called earlier the paradox of intelligence, since through its exteriorization, intelligence become confused in a world that is constructed by itself. In terms of dialectics, it demands reconciliation, *Versöhnung*, however, for human intelligence and machine intelligence, which is the father and which is the son is still not fully determined. In human history, we constantly renew our understanding of the universe and the world, each great discovery necessitates the renewal of the concept of the human. For example, with Copernicus's proposal of a shift from a geocentric to a heliocentric theory, the human species was no longer at the centre of a finite universe, but rather found itself confronting the infinite that lies far beyond itself, like a void. In parallel, we observe a new discourse on human subjectivity starting with the Cartesian *cogito, ergo sum*. The Enlightenment came later, bringing with it varied views on mechanism. On the one hand, the encyclopaedists found in mechanism the possibility of infinite progress and in the schematic form of knowledge (presented in the *Encyclopaedia*) the aspiration to democracy and technocracy. On the other hand, it was also the beginning of a

philosophy of the organism, which finds in the organism a new form of operation and organization, and consequently rejects the mechanist view of life and the state. The state, being mechanistic in its nature (in Hobbes), has to be reformed so that a true community could emerge in which mutual recognition is realizable (in Hegel).

The evolution of machine intelligence announces the end of humanism but also of the organic condition of philosophizing as laid down by Kant. Therefore, it remains our own task to specify this condition of philosophizing and the possible direction of a post-European philosophy. The end of the human is not so much about the hypothesis that machines will completely replace human beings, because this may take longer from now than the extinction of the human species; but rather that machine intelligence will transform humans to an extent that is beyond their own imagination. We are in a flux of metaphysical force, which is in the process of carrying humans to an unknown destination. This is also the mystery of modern technology. Will the transformation of the human lead to the extinction of *homo sapiens*? Or, will this transformation lead to an opening, one that not only rejects humanism, but also reopens the question of history and civilization, and therefore of life?

The duality that Bergson sets up between mechanism and vitalism as well as other dualist pairs, such as duration and space, matter and spirit, science and metaphysics, which wrongly gives his readers the strong impression that he is a dualist, is not exactly an "oppositional discontinuity." What interests Bergson more is the relation between the two: as he wrote, "truth itself, however, will be reached if two of them can be prolonged to the point where they intersect. In our opinion this method of intersection is the only one that can bring about a decisive advance in metaphysics."[20] Thus Gilles Deleuze could write in his *Bergsonism* that "dualism is therefore only a moment, which must lead to the re-formation of a monism."[21] Whether monism is an appropriate term to characterize Bergson's approach is another question, but for our purposes here, we may want to call this relation between the two poles an organological one.[22] For, indeed, Bergson does understand tools and instruments as artificial organisms,[23] and that mechanization is also a tendency of the evolution of human beings. Instead of seeing mechanization as a threat, one should re-situate machines in life or even in a "mysticism":

> The origins of the process of mechanization are indeed more mystical than we might imagine. Machinery will find its true vocation again, it will render services in proportion to its power, only if mankind, which it has bowed still lower to the earth, can succeed, through it, in standing erect and looking heavenwards.[24]

The élan vital is life itself, and mechanism has to recognize its origination and return to life. This is also the reason why Bergson suggests that "mechanism should mean mysticism." Mechanism wanted to explain life without life, while

Bergson wants to return it to a more primordial ground, and by doing so, he overcomes the dualities that he set up. To return to the élan vital and the world is not to repeat what Bergson and Heidegger have said, but rather to resituate technologies in broader realities beyond the calculable world. The way we talk about progress since the eighteenth century is dominated by the desire to measure, to calculate and to master. However, we also witnessed catastrophes, conceived as resistance of nature or the earth. They came not out of miscalculation, but are more fundamentally the result of the "transcendental illusion" of calculation. The task of philosophy—if such a possibility remains open—is to think beyond the *computable*/*incomputable* and therefore also to understand how the non-rational as *incalculable* is articulated in art and could serve as a method to reflect on *other possibilities* of computation.

§4. Intelligence and Technodiversity

I would like to return to the first opening quote, from Marvin Minsky's seminal paper "Steps Towards Artificial Intelligence" (1961), in which he commented on his own undertaking of intelligence, "[t]here is, of course, no generally accepted theory of 'intelligence'; the analysis is our own and may be controversial." Instead of claiming that we actually do not know exactly what intelligence is, I prefer to understand Minsky to be openly inviting us to *problematize* and even to *reinvent* the concept of intelligence. We might want to move a step beyond Dreyfus's great contribution, taking the concept of intelligence to a wider and wilder terrain, before we can return to reflect further on artificial intelligence.

Intelligence in so far as it is realizable through digital apparatus means that it is computable. However, what is meant by computable? It means *recursively enumerable*. What is recursively enumerable is only one type of intelligence among many others. Or more precisely, in the language of Bergson, it is only one of the tendencies of intelligence. It is nevertheless a technical tendency in the sense of André Leroi-Gourhan, because it is based on principles to maximize rational decisions and minimize contingent influences. This technical tendency follows and is motivated by a geometrical rationality, which for Bergson can also be an obstacle that life has to overcome, because it makes intelligence a stranger to itself and forgets its own ground. It is necessary today for us to contest the fantasy of possessing a super-intelligence which will finally be superior to all other intelligences and one day take over the role of the state. The fantasy of a super-intelligence is the expression of an extreme form of computationism and humanism, according to which the world is calculable and could be exhausted through calculation; it is also the highest form of neutralization and depoliticization via technology as analysed by Carl Schmitt. Our critique is not merely ethical—in the sense of maintaining a good relation between humans, and between humans and non-humans. On the one

hand, it is not certain that one can get out of a humanist epistemology by modelling artificial intelligence on insects, and different vegetable and animal life. Plants and slime molds may present us with insights concerning organismic principles, and therefore they may provide us with inspirations for improving algorithms, as has been done in "natural computing," a branch in computer science. This is, however, to subordinate these forms of life to calculability. On the other hand, in so far as human intelligence is concerned—and here we again follow Bergson—its strength comes from its capacity to invent inorganic tools and symbols: the human is first of all the *animal symbolicum* in the sense of Ernst Cassirer or a technical being according to André Leroi-Gourhan and Bernard Stiegler.[25] Plants and animals may be no less "intelligent" than human beings (though this comparison itself is already problematic), but they apparently employ far fewer symbols than do humans. Intelligence defined in this way belongs to the same process of evolution as hominization. Our world is a symbolic world, not only as representations or mental schemes, but also operations and processes based on these symbolic forms. What Bergson says about mechanism and mysticism is interesting but also important, since he refuses to see mechanism as a lifeless and repetitive operation, instead wanting to find a "bigger soul," in his own words, namely that which is capable of situating mechanism instead of being equated or determined by it. For Bergson himself, and later shared by Georges Canguilhem, this is to return mechanism to life.[26] This aim of returning mechanism to life has its possibility in mechanism itself, which could also be one way of interpreting Heidegger's quote of Hölderlin's poem *Patmos* in *The Question Concerning Technology* (1949): "But where danger is, grows the saving power also."[27]

How does this "returning" function? Bergsonian vitalism is one way, but we also have to explore other ways in line with Bergson and beyond Bergson. This leads to my thesis on techno-diversity.[28] I propose that noodiversity demands a technodiversity as its support, since homogenous technology means synchronization, and thereby homogenization. We must not confuse standards and homogeneity; we can have different industrial standards (as we have now even with electric voltage and electric plugs), but it does not mean that the applications built upon them are homogenous. Technology must be analysed according to different orders of magnitude, or in more technical terms, different levels of abstraction.[29] Each order possesses certain degrees of autonomy. In the same way, technodiversity is also made possible by noodiversity. By noodiversity, we mean the diversity of thinking and creativity. Here we can use Chinese thought as an example—but only as *an example*—to firstly clarify the relationship between intelligence and noodiversity, and secondly to have an idea about how *the incalculable* functions in intelligence—which is different from Heidegger's concept of the world or Bergson's élan vital. We emphasize that this is an example, since China and Europe are only fractions of this diversity. In Chinese, intelligence is often translated as *zhi hui* (智

慧) or *zhi neng* (智能), the former literally means wisdom, the latter the capacity of being intelligent, or the capacity to reason, or to become wise. We know that intelligence does not mean wisdom, since wisdom is a word often attributed to the oriental thinkers, who do not have philosophy! We want to ask what intelligence really means in Chinese thought.

When the New Confucian philosopher Mou Zongsan (1909–1995) read Kant's *Critique of Pure Reason*, he was astonished and at the same time enlightened, since he believed that the speculative reason that Kant wanted to limit is exactly what Chinese philosophy wants to cultivate. In his ambitious book *Chinese Philosophy and Intellectual Intuition*, Mou aims to show that if one follows Kant's systemic definitions of the operations and limits of the faculties of the spirit which grounded scientific knowledge, one can see that the intellectual intuition that is excluded from science has a central role in Chinese thought. In his *Critique of Pure Reason*, Kant delimits speculative reason by directing it away from the *Schwämerei* and enclosing it in land "surrounded by a vast and stormy ocean." Kant separates two realms, the realm of phenomena, which concerns appearances, i.e., objects of possible experience.[30] The noumenon is the other realm in which things are objects merely of the understanding, and not objects of sensible intuition.[31] Human sensible intuition cannot penetrate into the noumena, namely we cannot positively demonstrate the noumenal entities, for example, the thing-in-itself. In Kant's practical reason, the noumena are also the postulates of practical reason, for example the absolutely free will, immortal soul and God. Knowledge, in so far as it aims to be objectively valid, has to be based on the sensible cognition (of phenomena). For sure, one can always try to speculate beyond the phenomena since this act belongs to human freedom. One can always dream, for example, yet in so far as such knowing cannot be grounded, it is mere speculation, and therefore excluded from scientific knowledge. The noumenon therefore is negative, and can only have a positive meaning when there is an intellectual intuition corresponding to knowing it.[32] In the first *Critique*, Kant has already rejected the possibility that human beings possess intellectual intuition, instead insisting that human beings can only have sensible intuition. Sensible intuition is the land where reason labors and beyond which it may drown itself in the ocean.

According to Mou, in the synthesis of Confucianism, Daoism and Buddhism, which we call Chinese thought today, what is prominent is the cultivation of an intellectual intuition penetrating beyond the phenomenon and reuniting the phenomenon and the noumenon. For Mou, intellectual intuition is not innate. When one is born, one does not necessarily possess intellectual intuition, only sensible intuition. This is also the difference between Mou Zongsan and Schelling (as well as Fichte) since such intellectual intuition needs development, it is not that which is already given at the beginning and that grounds the systemization of knowledge. So Mou's intellectual intuition is neither purely *a priori* nor *posteriori*: it is not

purely *a priori* since it is unlike sensible intuition handed down within the species; it is not purely *a posteriori*, because it is not entirely developed from experience since the possession of intellectual intuition is what distinguishes humans from other animals. The ideal figures, like the sage for Confucianism, *zhengren* (literally the true person) for Daoism and Buddha for Buddhism, are those who have cultivated their intellectual intuition.

What exactly is this intellectual intuition and how does it work according to Mou Zongsan's reading of Chinese thought? We risk simplifying it in this way: intellectual intuition is the synthetic reason which understands the relation between the self and other beings (or the cosmos) from the perspective of a moral subject instead of a subject of knowledge. The moral subject and the subject of knowledge are two tendencies of human development. The moral subject is prior to the subject of knowledge. A subject of knowledge, when looking at the world, wants to comprehend the world through analytic decomposition, while a moral subject looking at the world sees the inter-connectedness of things from a synthetic reasoning that always seeks the unification between the cosmic order and the moral order—this also being the foundation of the concept of cosmotechnics.

What does it really mean? In *Intellectual Intuition and Chinese Philosophy*, and in the later and more mature *Phenomenon and Thing-in-Itself*, Mou Zongsan attempted to show that intellectual intuition is fundamental to Confucianism, Daoism, and Buddhism. For Mou, intellectual intuition is associated with creation (e.g., cosmogony) and with moral metaphysics (as opposed to Kant's metaphysics of morals, which is based on the subject's capacity for knowing). Mou finds theoretical support in the Chinese classics, especially the Neo-Confucians, for example Zhang Zai's work. Zhang Zai is a thinker of the eleventh century who is known for his moral cosmogony based on a refined theory of ch'i (energy, literally gas). We want to particularly look into this passage cited by Mou:

> The brightness of the heaven is no brighter than the sun, when one looks at it, one doesn't know how far it is from us. The sound of the heaven is no louder than the thunder, when one listens to it, one doesn't know how far it is from us. The infinity of heaven is no greater than the great void (*tai xu*), therefore the heart (*xin*) knows the heaven's boundary without exploring its limits.[33]

Mou notes that the first two sentences refer to the possibility of knowing through sensible intuitions and understanding; the last sentence, however, hints that the heart is able to know things that are not limited to phenomena. For Mou, the capacity of the 'heart (*xin*)' to 'know the heaven's boundary' is precisely intellectual intuition: it does not refer to the kind of knowing determined by sensible intuitions and the understanding, but rather to a full illumination emerging from the *cheng ming* of the universal, omnipresent, and infinite moral *xin*.[34] In this full illumination, beings appear as things-in-themselves rather than as objects

of knowledge. *Cheng ming*, literally 'sincerity and intelligence,' comes from the Confucian classic *Zhong Yong* (*Doctrine of the Mean*).[35] According to Zhang Zai, "the knowing of *Cheng ming* reaches the *liangzhi* (moral conscience) of the heaven, and is totally different from knowing through hearing and seeing."[36] Thus knowing based on intellectual intuition characterizes Chinese philosophy and its moral metaphysics.

We may also refer to the passage from *Xi Ci*, one of the most important commentaries on the *I Ching* or *The Book of Change*, which Mou Zongsan also cited. In *Xi Ci* we read: "*I* (易) is non-thinking and non-doing, it is silent without movement, however, when it is put to use, it feels and connect the whole universe."[37] *I* carries three meanings, no change (不易), change (變易) and simplicity (簡易). Commenting on a passage of *Xi Ci* which discusses using turtle shells and milfoils for divination, Mou Zongsan says:

> Although the turtle shell or milfoil are thoughtless, when you work through it, when you present your question, when there is a resonance, it will know the whole world. . . . So to feel in order to know the world, is like to feel the whole cosmos. *The idea of feeling the whole cosmos is most solidly expressed in the pre-Qin Confucianism, indeed, this is what Kant called intellectual intuition*.[38]

Mou equates this *ability to feel* with what Kant calls intellectual intuition.[39] Far more qualifications will need to be given here,[40] but Mou has the intuition that there is a way of knowing beyond phenomena, and this is the source of the moral. For, indeed, we cannot ground morality on analytics, unless we believe in the kind of axiomatization we hear coming from the ethics of technology today. However, when we talk about the ethics of technology, we have already presupposed a specific kind of subject of knowledge and reasoning and assumed a certain normativity. Instead of axiomatizing the moral, we will have to go back to different modes of knowing which have yet to be taken into consideration by engineers and scholars working on artificial intelligence.

If Mou Zongsan was right that intellectual intuition, rather than analytic reasoning, stands out as the core of Chinese thought, then we can see that there is a fundamental difference in terms of the definitions of intelligence. This difference contributes to the technodiversity of future technological development. This does not mean that we are proposing that machine intelligence will have to implement intellectual intuition, though this can always be an interesting experiment because it may point to a veritable "technological singularity" or "intelligence explosion" (imagine the machine is able to produce what it intuits). Instead, this brief investigation undertaken here is an attempt to show that intelligence is not limited to the models of calculability nor to the analysis of phenomena. On the contrary, the notion of intelligence, including the technical medium/support on which it relies, has to be enlarged in two senses. Firstly, it has to be resituated in broader

realities, which exceed sheer rationality and will require taking the non-rational into consideration; secondly, intelligence has to be understood together with its symbolic support, instead of excluding symbols from intelligence or considering them as secondary (this happens very often when one thinks one can simply "extract" models of intelligence from slime molds and insects).[41] The challenge of artificial intelligence is not about building a super-intelligence, but rather a matter of facilitating noodiversity. And for noodiversity to be possible, we will need to develop technodiversity. This is also how cosmotechnics is distinguished from the "ontological turn" (which looks at nature from the perspective of different cultures) and "political naturalism" (which looks at culture from the perspective of an organismic nature), because we maintain the hypothesis that we have to urgently develop a technodiversity as our orientation towards the future. It is, at the same time, a reconstruction of the histories of technodiversity (and, more *methodologically*, of cosmotechnics) which have been obscured by the pursuit of a universal history of technology (and also the universal history of the human kind), and a call for experimentation on art and technology for the future. This reflection on the limit of something without limit is not to delimit the possibilities of artificial intelligence; in the contrary, it is an invitation to reflect on the other possible paths of technology.

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Notes

1. Bergson, *Creative Evolution*, 153–54: "In short, intelligence, considered in what seems to be its original feature, is the faculty of manufacturing artificial objects, especially tools to make tools, and of indefinitely varying the manufacture."
2. Ibid., 153.
3. See Hui, *Recursivity and Contingency*.
4. It is not uninteresting to ask how statistical mechanics was instrumental to Wiener's cybernetics, since he uses statistical method to bridge irreversible entropic time and reversible Newtonian time, which we briefly mentioned in "Machine and Ecology." See also Guerlac, *Thinking in Time: An Introduction to Henri Bergson*, 32: "A few years later (1876), Josef Loschmidt addressed the following question to Boltzmann: if entropy is an irreversible process (one does not observe a cold material becoming spontaneously warmer over time) how can you claim to derive it from a model that corresponds to reversible laws? Boltzmann responded to this challenge with a paper in 1877 that characterized entropy in terms of mathematical probabilities through a statistical analysis. This is the beginning of what will become the field of statistical mechanics. When he translated the law of entropy into the terms of classical mechanics, and then adjusted this to statistical analysis, Boltzmann obscured

the implications of the second law of thermodynamics concerning the reality of psychological time that Bergson will call Real Duration."

5. Wiener, *Cybernetics*, 44.
6. Bergson, *Creative Evolution*, 288.
7. Hui, *Recursivity and Contingency*, chap. 1.
8. "The obligations which it lays down, and which enable it to subsist, introduce into it a regularity which has merely some analogy to the inflexible order of the phenomena of life." Bergson, *The Two Sources of Morality and Religion*, 3.
9. McCulloch and Pitts, "A Logical Calculus of the Ideas Immanent in Nervous Activity," 115–33.
10. Simondon, "Epistémologie et Cybernétique," 180.
11. Malabou, *Morphing Intelligence*, 113.
12. Labarrière, "L'intelligence," 430.
13. For a historical account, please refer to Hui, *Recursivity and Contingency*, Chapter 1, on Kant, Fichte and Schelling, and Chapter 2, on Hegel, cybernetics, Alan Turing and Kurt Gödel.
14. Günther, "Seele und Maschine," 85.
15. Dreyfus, *What Computers can't do*, 122.
16. Ibid., 122–23.
17. Dreyfus aspired to connectivism, which is the foundation of neurodynamics and neural networks.
18. Smith, *The Promise of Artificial Intelligence*.
19. We started the trajectory of such a re-reading in Hui, *On the Existence of Digital Objects*, esp. chaps. 3–4.
20. Bergson, *The Two Sources*, 237. This quote is also cited in Deleuze, *Bergsonism*, 29.
21. Gilles Deleuze, *Bergsonism*, 29.
22. In Chapter 3 of *Recursivity and Contingency*, we elaborate on the question of the relationship of the term "general organology" to Bergson's philosophy. Georges Canguilhem, in his 1947 article "Machine and Organism," attributed this term to Bergson's 1907 *Creative Evolution*.
23. Bergson, *The Two Sources of Morality and Religion*, 267.
24. Ibid., 268.
25. Though there is a nuance, for Bernard Stiegler in *Technics and Time*, vol. 1, criticizes Leroi-Gourhan's notion of the second origin, namely the discontinuity between *homo sapiens* and the Neanderthal, since only the former is capable of inventing symbols which gives rise to art and poetry.
26. See Canguilhem, "Machine and Organism."
27. Heidegger, "The Question Concerning Technology," 34.
28. See Hui, "Machine and Ecology," 54–66, and Hui, "Writing and Cosmotechnics," 17–32.
29. Hui, *On the Existence of Digital Objects*.
30. Kant, *Critique of Pure Reason*, A248, B305. Kant writes: "appearances, insofar as they are thought as objects according to the unity of the categories, are called phenomena."
31. Ibid., A249, B307.
32. Ibid., B307.

33. Mou, *Intellectual Intuition and Chinese Philosophy*, 184. I adopt the translation of *tai xu* as 'great void' from Billioud, *Thinking through Confucian Modernity*, 78:「天之明莫大於日， 故有目接之，不知其幾萬里之高也。天之聲莫大於雷霆， 故有耳屬之，莫知其幾萬里之遠也，天之不禦莫大於太虛，故心知廓之， 莫究其極也。」
34. Mou, *Intellectual Intuition and Chinese Philosophy*, 186.
35. In the ancient text (date unknown) *Zhong Yong* (*Doctrine of the Mean*), one reads (1893, translation modified):「誠者天之道也，誠之者，人之道也；自誠 明，謂之性。自明誠，謂之教。誠則明矣，明則誠矣。」: "Sincerity is the way of heaven. The attainment of sincerity is the way of men. . . . When we have intelligence resulting from sincerity, this condition is to be ascribed to nature; when we have sincerity resulting from intelligence, this condition is to be ascribed to instruction. But given sincerity, we shall have intelligence; there shall be the sincerity."
36. Mou, *Intellectual Intuition and Chinese Philosophy*, 188.
37. 「易無思也，無為也，寂然不動，感而遂通天下之故。」
38. Mou "Lectures on Zhou Yi," 137. In Chinese:「它本身雖然是無思、無為的龜 䇲、蓍草，但你藉著它做工夫，你一問，你有問的感應的時候，它一通就通天下之故。 . . . 所以感而遂通天下之故，這個等於一通全通，感通全宇宙。 感通全宇宙這種觀念先秦儒家最有實感，這個就是康德所說的 Intellectual intuition 。」
39. Mou "Lectures on Zhou Yi," 141:「『寂然不動，感而遂通天下之故』這個就卜筮講，把這個觀念用在我們的本心上來，譬如說用在王陽明所講的『良知』，用在孟子所講的四端之心，這個寂然不動的『寂』就指良知的明覺講。寂然就等於良知本心的明覺，寂然不動的『寂』就指良知的明覺講。」
40. We have already explored this in Hui, *The Question Concerning Technology in China*, and we will continue to elaborate it in a forthcoming work, *Art and Cosmotechnics*.
41. In related to our discussion on Kant and the function of symbols (or artificial memory) in cognition, which Kant himself has also undermined, see Stiegler, *Technics and Time*, vol. 3.

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