Can Artificial Neural Networks Be Normative Models of Reason?

Limits and Promises of Topological Accounts of Orientation in Thinking

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Abstract: *The history of thinking about thinking is populated by numerous attempts to model reason in topological terms. Amongst them, the prominent place is occupied by Immanuel Kant's explanation of thought's need to restrain its own exercise by means of an analogy between geographical orientation (modeled on the human body) and orientation in thinking. As natural as his analogy might seem, the first part of this chapter aims at deconstructing Kant's attempt as both replaceable and constraining, and at proposing a possibility of alternative topological accounts of thinking. Hence, while endorsing the utility of spatial models, we call for an unbinding of the parochial connection between thinking and the form of the human body implicit in historical topological models of reason. For this reason, in the second part of the chapter we suggest that the topological framework embodied by Artificial Neural Networks (ANNs) can be used as an alternative to formulate such a model of thinking, based on their commitment to dimensionality and use of space as an active, dynamic and transitory element. Rather than arguing that ANNs somehow think, we suggest that they offer a mirror that lets humans look back at themselves and construct their thinking differently. We conclude by proposing that the benefit of looking in this mirror is open-ended and twofold: (1) It divorces our image of thinking from anthropomorphism, and (2) it offers a normative model of reason with potentially practical consequences for how humans act.*

1. Introduction

The intellectual history of space, at least in the Western tradition of mathematics, has been that of a concept long subjugated to set theory, starting with the Euclidean definition of space as a set of points. However, the last two centuries marked a departure from this perspective, positing logic or algebra as derivative from the operations with spatial or space-like concepts (Plotnitsky 2012: 355). It started with breakthroughs in geometry initiated by Galois, Abel, Poincaré and Riemann, leading to topology – a discipline concerned with an abstract inquiry into the nature of space – being instituted as the general discovery of surprising relations between distant fields of mathematics (Zalamea 2012). Topology also became the generic means of identifying and treating abstract structures. This made possible a true ontological Cambrian explosion in contemporary mathematics, illustrated by the success of category theory as potentially the new foundational programme for mathematics. The aim of this chapter is to take stock of how this topological turn has reverberated beyond the disciplinary confines of mathematics, returning space to the center of philosophy and computation.

In philosophy, Kant famously argued that space is an a priori condition of experience, meaning that no objects could be cognizable without being located in space (e.g. Kant CPR B73). But here we will discuss one of Kant's other intriguing insights – namely, an analogy between orientation in thinking and geographical orientation (Kant AK 8: 133–146). This analogy will help us explore intuitions about the relationship between topology and cognition, which we will valorize in the discussion of artificial neural networks (ANNs). ANNs represent today the most successful cluster of computational technologies that fall under the rubric of artificial intelligence (AI). They excel in pattern recognition based on sound or visual data, and they find their application in the processing of voice commands, biometrics, text translations etc. Apart from that, the most recent branch of ANNs, such as GPT-3 or DALL-E 2, is capable of automated generation of new text, sound or visuals, which find numerous applications in the sciences, arts and different industries.

What made these highly abstract technologies into such powerful tools of statistical inference is their topologization of computation, which lies in representing real-world data in n-dimensional space and applying regression analysis to arrive at an adequate way of modeling them. This may be a starting point for updating the Kantian topological metaphor of orientation, which in turn may lead to: (1) a reassessment of critiques of instrumental, enumerative rationality that ANNs are claimed to embody; and (2) a philosophically warranted alternative to understanding orientation in thinking. The latter may enable us to uncover some normative implications of the computational topology of ANNs, without providing a normative theory of topologies in general.

2. Kant's geographical model of orientation in thinking

In his essay What Does It Mean to Orient Oneself in Thinking? (Kant AK 8: 133–146), Kant presents an analogy between geographical orientation (of one's body in a physical space) and orientation in thinking. His exposition begins with a description of geographical orientation, which includes a subjective ground of differentiation structured roughly according to the symmetry of the human body in terrestrial space.

In the proper meaning of the word, to orient oneself means to use a given direction (when we divide the horizon into four of them) in order to find the others – literally, to find the sunrise. Now if I see the sun in the sky and know it is now midday, then I know how to find south, west, north, and east. For this, however, I also need the feeling of a difference in my own subject, namely, the difference between my right and left hands. I call this a feeling because these two sides outwardly display no designatable difference in intuition (Kant AK 8: 134–135, original emphasis).

Kant supports this claim by an example of navigation of one's body in the dark. Even if one is present with no objective data about space owing to lack of visual stimuli, orientation is still possible by means of a subjective ability to distinguish between left and right (Kant AK 8: 135). For Kant, a subject trying to navigate the world has the innate ability to notice the structure of its body in relation to the surrounding world. Analogously, reason also needs a navigational principle of its own once it leaves the turf of experience to venture into the speculative realm. Orientation in thinking thus refers to a "reason's feeling of its own need" (AK 8: 136) to ground its proper use on rational faith similar to subjective differentiation of left and right. Prudent reason chooses to restrain itself according to maxims because it realizes that over-enthusiasm would amount to squandering its freedom to think (Kant AK 8: 144–146). He writes in a footnote: "Thus to orient oneself in thinking in general means: when objective principles of reason are insufficient for holding something true, to determine the matter according to a subjective principle" (AK 8: 136).

What is remarkable about Kant's definition of orientation in thinking as a paradigm of rational self-constraint is that it uses an empirical case as its privileged model before the actual definition is given. We learn about what orientation in thinking really means in a footnote only after the imagery of finding the sunrise has been presented. Although the meaning of orientation in thinking is clear enough, Kant's way of presenting it seems driven by a temptation to talk about thinking in terms of spatial analogies. The reader is invited to imagine reason standing somewhere at dawn with a compass, even though thinking in general, and reasoning in particular, has little to do with the sort of space Kant refers to in his first exposition of orientation, quoted above (AK 8: 134–135).

But if there is no intrinsic relationship between thinking and geographical space, what was Kant's justification for talking about reason's behavior in these terms, which was probably a didactic choice? Could it be that there are other models to which thinking can refer in interpreting its orientation? To answer these questions, let us first examine the meaning of Kant's concept of orientation in more detail. We will gloss the point he makes about the distinction between left and right, and focus on the consequences of using this concept of orientation as a model for reason's need to constrain itself.

Kant bases his analogy on the space of sensomotoric orientation. In discussing the difference between left and right he has in mind a chiral structure or distinction between non-superimposable mirror images such as our hands (which appears to have been a small obsession of his). Earlier in his career he believed that incongruent counterparts were a means to critique Leibniz's concept of space as fully explicable by the relations between its 'occupants'. For Kant at this time, only an absolute space, as proposed by Newton, could make it possible to identify incongruent counterparts (e.g. Kant AK 2: 379). His dissatisfaction with the Leibnizian notion of space was a significant step toward the transcendental aesthetic and the entire critical system, where a Euclidean space would become one of the subjective conditions of objective knowledge, as constitutive of our form of outer sense. The development of Kant's thought points to tensions in the concept of orientation he uses in his essay on the topic:

1) If space is a form of sensibility in which one can orient oneself, it cannot be exhausted by relations between its contents because otherwise (following Kant's earlier argument) one could not identify left and right. This is the subjective 'feeling' which Kant refers to when he talks about chiral structures in the orientation essay and elsewhere.

2) Orientation utilizes the subject's ability to tell or 'feel' the difference between left and right in the structure of its sensibility, which in Kant's example, however, can only be an experiential act because hands are given as objects in space.

Kant's critical account of space as the form of outer sense delimits how we interpret the concept of orientation he discusses in the essay. The concept of orientation is understood as an empirical act of finding one's way in a space divided in four cardinal directions. The image of a compass is a bit misleading, however, since Kant's point is that orientation depends on an unexplained "feeling of a difference in my own subject" (Kant AK 8: 135) that persists even without perceiving any objects. The subject is equipped with a kind of intrinsic compass. But it is hard to see how there can be no objects at all, since the essay makes references to at least one body: the Kant-shaped object at the center of his geographical space. Add to this that the cited ability to differentiate between left and right has allegedly been imparted to us by "nature" (AK 8: 135), and it is clear that the concept of orientation refers to actual, embodied experience. Yet it is transcendentally constrained by the constitution of the human form of sensibility. So if reason can orient itself analogously to how we orient ourselves in darkness, this should – as far as Kant ought to think – first of all be understood as an analogy between a subjective principle of reason and the orientation of a bilaterally symmetric body represented in a Euclidean space. That is, the operative concept of orientation is tailored according to Kant's philosophical interpretation of an empirical case of orienting himself, which is in turn based on the concept of space that he thinks we are entitled to. We will refer to this as 'geographical orientation'.

Geographical orientation is the basis of Kant's construal of thought's need to assume things that it cannot know on objective grounds. But note here that Kant does not presuppose that thinking itself is spatial – in his architectonics of human cognition, space is a form of sensibility, and thus belongs to the apprehension of what is exterior to the subject. Hence, to orient oneself in thinking cannot mean in the space of thought but rather in the case of thinking (as opposed to experience). The problem is that Kant assumes the geographical model is suitable for explicating reason's need. At stake here are the languages, images and models we use to understand thinking. On the one hand, we think that Kant skillfully demonstrates the value of using a spatial concept such as orientation to think about thinking, but on the other hand, it is not clear to us why orientation in thinking must be understood with reference to the geographical model. If it is not necessarily so, it is possible that thought's self-orientation can be construed in other terms, through other topological analogies or empirical prostheses. Such alternatives may help us construct different norms for how thinking should behave with regard to itself, or at least open the floor for new lines of inquiry about the behavior of thought, unbinding reason from the common-sense model it finds in geographical orientation.

3. Topology of reason after Kant

Kant's analogy effectively discloses a model based on geographical orientation, where orientation functions as a heuristic to draw conclusions about what reason is justified in doing, indeed even what it needs to do. This means that the model has normative consequences. Though Kant may be right to explain how reason should behave using his orientational standard, orientation is understood as a geographical term which for Kant appears to have a subjective structure as a matter of objective fact – as demonstrated by his argument about incongruent counterparts that form the basis for navigation even in darkness. But why should reason 'feel' a subjective need that is explicable through this concept of orientation? In the next few paragraphs, we will argue that for the purposes of philosophy, there are benefits to considering alternative models which, on the one hand, concur that a topological explication of the standards of reason is meaningful but, on the other, are prepared to reject Kant's interpretation of what this means.

An answer to why the geographical interpretation of orientation appears privileged prima facie is a historical affinity between geographical space and reason. One of the more tantalizing ideas about the relationship between reason and space is developed by the time-space sociologist Bernd Schmeikal-Schuh, according to whom there is a structural homeomorphism between an original concept of orientation which reflects the structure of perceptual space and the operations of Boolean algebra (Schmeikal-Schuh 1993). Logic, it is hypothesized, may have been learned as a result of an increasing historical awareness about orientation. As Schmeikal-Schuh puts it plainly, "the laws of thought may have developed out of the original structure of orientation in space" (1993: 130). Here we have the outlines of a genetic account capable of explaining the basis of Kant's analogy. Even if his explanation cannot be verified as an actual historical process, Schmeikal-Schuh shows how reason can feel a need to orient itself not because it is spatial per se but because its fundamental "grammar" is understood in terms which are translatable into a concept of orientation in space. In this respect, Schmeikal-Schuh's argument contributes two relevant points: 1) a claim about how thought acquired a particular logical structure; and 2) a justification of reason's felt need to orient itself in analogy to orientation in space. Although Schmeikal-Schuh does not understand logic in quite the same way as Kant, he nevertheless provides a cultural history to explain how thought can have found a model in geographical orientation.

Still, there is nothing to guarantee that thinking can be exhausted by this particular concept of orientation. The problem of such an interpretation, already at work in Kant, is an assumption that perceptual space, even if historically relevant, holds normative force for understanding orientation in the case of thinking. Even if reason feels a certain need to orient itself, why should orientation be understood on the basis of a particular logic? Even in the dark of night reason feels the need to constrain itself according to a concept of orientation which is drawn from an empirical case. A grammar of reason may well be inherent in the transcendental structure of space but its proper use is taught from an empirical case of geographical orientation. The problem is reminiscent of the one produced by Gilles Deleuze's criticism of a "dogmatic image of thought" (1994) which models its own nature on the basis of an empirical case. A thought which constrains itself in this manner is engaged in its own becoming-docile, a concrete process of learning what is proper conduct based on a privileged empirical case. Faced with darkness, it is as if the source of normativity in Kant's analogy comes from an assumed principle that thinking should acquiesce to that which is most familiar, namely an image of the human body in a Euclidean space.

Against the historicist rationale presented by Schmeikal-Schuh, an interlocutor might propose an essentialist alternative: that it is space as the form of outer sense, which is a precondition for experience, that is at work in the analogy – such that thought is justified in portraying itself in accordance with geographical space, not out of familiarity but because it refers to the necessary space presupposed by experience in general. The interlocutor might argue that not only does geography give us one model for orientation, it supplies a model which is derived from the structure of receptivity and is therefore basic. But the cost of such an argument is to bind reason's sensibility so that acquiescence to the model is a guarantor rather than a mere comfort: no acquiescence, no ability to understand orientation in the case of thinking. The consequence of the essentialist alternative would be to shackle freedom of thinking to the human sensory apparatus – a claim that Kant would not have supported, careful as he was to distinguish between humans and the broader concept of rational beings (see for example AK 4: 412). Still, on the essentialist account there is just no more fundamental case than geographical orientation on which reason could model its felt need. But – and this is a crucial point – the interjection hinges on Kant being right about what sort of space is necessary for experience, or else it is hard to see why geographical orientation should be privileged.

In fact, it is no longer clear that it is, even on the terms of Kant's own argument. For example, in some of his earliest work Rudolf Carnap attempted to disambiguate between different meanings of space in philosophy, physics and mathematics. One of his conclusions was that Kant would have needed a topological concept of space in order to find a necessary ground for experience: a physical or projective space would simply not suffice (Carnap 1922). If Carnap is right, one could remain broadly Kantian but distinguish between the represented space of geographical orientation and the space necessary for experience. In the case of experience, we would be entitled to a loftier notion of space than that proscribed by Kant. In that case we might be able to accept the possibility of another normative account of reason's orientation based on a concept of space if we hold to such a topological notion that is irreducible to metrical or projective properties. In other words, it is the geographical orientation model that proves to be limiting insofar as geographical orientation foregrounds a concept of physical space with Euclidean roots. So even if it is historically warranted, Kant's image of reason's proper conduct derived from orientation in space appears to be, on different accounts, neither exhaustive of thought's potential nor (even to the Kantian acolyte) adequate to describe the necessary conditions of experience. In both cases, an image of reason's orientation does not need to be beholden to what Kant construed as geographical orientation. It is plausible to think there could be other models for orientation in thinking that are not restricted to an image of a bilaterally symmetric animal at the origin of a Euclidean projection.

4. Mathematical topology and ANNs

To recap, even though Kant does not say that thinking is spatial, he demonstrates how to think about thinking in spatial terms: that a topological modelling of thinking is possible and that it can be insightful. From Schmeikal-Schuh and Carnap, we can see now that the model of orientation of thinking does not have to be bounded (and should not be bounded) by the metric space of geographical orientation. This opens up possibilities of integrating discoveries in the field of topology since Kant wrote his contribution. In other words, we are seeking a prosthetic model that would remain topological while allowing us to escape the boundaries of the models of orientation based on metric, projective space in general, including its narrowly Kantian version. Such a topological model of orientation would be especially welcomed if it already manifested some success in orienting other modes of conducting inferences beyond the case of human thinking – a sort of proof-of-concept for a topological model that aspires to be scaled up to the level of an alternative normative project. Interestingly, there is one such case at hand in the twenty-first century – the emergence of ways of apprehending the world explicitly based on topology in artificial neural networks (ANNs). The calculus behind ANNs relies on discoveries associated with the topological turn in computation, as explained by authors such as Pasquinelli (2019) and Cavia (2022), and more deeply with the topological turn in mathematics (Zalamea 2012), that resulted from liberating the notion of space from the confines of set theory. As Cavia and Reed reiterate in this volume (pp. 353–365), instead of space being treated as a set of points with additional structure, the structure becomes treated as inherent in space, which allows for an alternative approach to topology, as a general study of abstract structures. Or to put it differently: "Topological treatment of space is always a means of gleaning a structure latent in the space" (Cavia 2022: 112).

Most importantly, Zalamea associates this topological turn with a synthetic, constructive style of conducting mathematics, which pays special attention to "incessant pendular processes of differentiation and reintegration" (2012: 123). This style takes its guidance from Peirce's pragmatism, which "benefits from an attentive examination of the contaminations and osmoses between categories and frontiers of knowledge so as to articulate the diversity coherently" (Zalamea: 111). Such an orientation of thinking toward gestures of integration without homogenization proved to be fruitful in constructing new frontiers of mathematical discoveries, especially since Alexander Grothendieck's work on algebraic geometry and topoi theory (Zalamea: 133). Grothendieck established a relativistic perspective on the nature of truth in mathematics, which becomes indispensable from identifying its context (or locale, topologically speaking – see Cavia and Reed (2022) in this volume). This move allows proper maintenance of diversity/discontinuity within the field of mathematics, while at the same time facilitating categorial transitions between distant domains of this field (e.g. between geometry and logic), thereby leaving enough space for possible reintegration of what is diverse/discontinuous. Turning these discoveries into a normative model would mean that any integrative pursuit is linked in a pendular fashion to enunciation of a new platform of diversification – a maxim perhaps too abstract at the moment, yet already affording a glimpse of some of its political consequences. Our belief is that through close examination of the topological aspects of ANNs, we can arrive at a constructive project of reason (i.e. of its orientation) that would adopt these normative stakes endemic to mathematical topology.

To turn our attention to the case of ANNs, their explicit use of topology breaks down to the employment of dimensionality in their representation of data. ANNs represent parsed information from input data in a high-dimensional space, where the number of dimensions depends on the number of individual neurons in the network. Each dimension thus maps a unique subspace of the total datascape incommensurable to other subspaces within the datascape. Take an example of a simple dataset called MNIST, composed of images of handwritten numbers, each image of size 28x28 pixels. A neural network used to process this database would need 784 neurons on the input layer, meaning also 784 dimensions to represent the input data. That is a fairly high-dimensional space, but it would be just a beginning: to obtain meaningful results (e.g. to use ANN as an autoencoder capable of classifying handwritten digits with values from 0 to 9), one would need to add hidden layers and of course also its output layer, which would multiply the number of dimensions, ending with a number of dimensions with at least five or six digits, depending on the number of hidden layers and the number of neurons within each of them.

Still, such mapping of real-world data into its abstract, topological representation is an operation of reduction, which lies in rendering the continuous nature of reality (expressible as a topology with infinite dimensions) into its segmented, hence computable version. The resulting n-dimensional structure, known also as latent space, can thus be approached as a model of reality that uncovers the latent structure present in the data, and uses topology to figure out the relations between elements in the dataset. The training of such a model to successfully detect desired patterns, when presented with new inputs, also exhibits explicit topological aspects. As Cavia states:

> Manifold learning involves smoothing data into a continuous surface, as a planar representation on which locality can be expressed between points, an operation only possible via dimensionality reduction of real world data. The real is cast as a tangled complex of manifolds, and the ability of AI to

> recognize patterns becomes a matter of fitting a curve to a topology of points in this geometric interpretation. (Cavia 2022: 142)

Our conjecture is that procedures within the latent space of ANNs lead to a widening range of topological models suitable for interrogating how we describe human thinking, without resorting to a claim that ANNs "think" in some sense. Just as geographical orientation was a useful model for Kant in explaining the structure of orientation in thinking which turned out to have normative consequences (without assuming that by walking one somehow engages in an act of thinking), so the n-dimensional latent space of ANNs provides an alternative, topological rendering of inferential procedures – but with what consequence?

5. Beyond the critique: The project of topological reason

The consequence of topology's prevalence over set theory in setting out the foundations of contemporary mathematics is aptly described by Vladimir Voevodsky. While reiterating basic components of Zermelo-Fraenkel set theory with the axiom of choice, he notices that set theory is "based on the human ability to intuitively comprehend hierarchies" (Voevodsky 2014). Yet category theory – the most successful project of constructing topological foundations for mathematics – departs from this intuition at its fundamental layer, leading to an ability to appreciate non-hierarchical structurations and transits that are better suited to grasp the continuous nature of the real. No wonder, then, that Grothendieck – as one of the pivotal contributors to category theory – has been infusing mathematics with his anarchical political views (Plotnitsky 2012: 365). His method of "experimental mathematics" allows for the flourishing of "horizontal interactiveness" between logics emerging from the multiplicity of conceivable topologies (2012: 363, 367). Such a non-hierarchical account informs another approach to constructing and setting relations between abstract objects, one that spills over from the hierarchical intuition of set theory toward a project of reason that is not primarily reliant on the gestures of subsumption. On top of that, such a topologically informed model of reason lacks the disadvantage of Kant's empirically loaded model based on geographical orientation, since it removes familiarity with projective, metric space as the source of normative traction.

Subsumption, hierarchy, stiffness of categorial matrices – these are pathologies associated with instrumental, enumerative rationality criticized in contemporary writing on AI by authors such as Pasquinelli (2017a, 2017b). The template of this critique can be found in Heidegger's analysis of modern technology, which claims that its essence lies in enframing: a mode of epistemic rendering of the real that aims "to reveal the real, in the mode of ordering, as standing-reserve" (1977: 10) – as something that is "ordered to stand by, to be immediately at hand" (1977: 8). To put it differently, Heidegger here manages to link the optics on the real that modern technology presupposes with a mode of administration of the real. The administrative goal is to transform the real according to the template of the "standing reserve" that enframing by modern technology suggests. Similarly, it is claimed today that ANNs serve a function of classifying real-world objects (and subjects) into stereotypical categories (e.g. based on race or gender), thus following that tradition of enframing, otherwise explicable as instrumental, enumerative rationality. Hence it is widely assumed that these advanced practices of "marking territories and bodies, counting people and goods" (Pasquinelli 2019) solidify distinctions based on the aforementioned stereotypical categories, and perpetuate forms of social, political and economic control.

While it is surely true that no technology is politically neutral, our argument is that it may be too hasty to say that ANNs are somehow inherently tainted by the consequences of their emergence and use in a given socio-historical context. Such a critique numbs us to the deep topological turn propagated by AI. Although the political-economic and media-theoretical critique of AI correctly focuses on how ANNs may be used for purposes of social division and control (e.g. Crawford/Joler 2018; Srnicek 2017; Pasquinelli 2017b), it misses the point if it puts too much focus on the computational logic of ANNs, because this logic is not predestined for this purpose. Hence, as an alternative to the approach that binds the computational logic of ANNs to a given socio-historical context, we propose to think about it as a guide to a generic topological model (or image) that can be projected on the case of human thinking to yield various results. By opening up the space for diversification, this idea bears similarity to projects such as Yuk Hui's cosmotechnics, which also conditions technological rationality by a more general topological structure that goes by the name of cosmos (Hui 2016: 18–33). In this sense, cosmos is an example of a concept that unifies spatiality and normativity, referring to the ancient Greek meaning of the term that captures universe as a total "world-space" together with its normative dimension – the cosmic order

– and the aesthetic dimension of the perfectness of this order (Pascal 2014: 1218).

In a similar vein to the anthropological discussion of cosmology that works for Yuk Hui, we propose here that the computational logic of ANNs can function as a sort of philosophical lever, letting us gaze back at the normative standards that pervade our thinking. Such leverage can come from reflecting on the topological aspects of how ANNs operate and feeding these reflections back into the conversation about human reason, thus surpassing those critiques that lock the future of AI technologies firmly into the space of instrumental, enumerative rationality. Hence, to say that reason is topological is a constructive act, not an ontological uncovering of reason's essential affinities. It may therefore be better to speak of reason becoming topological, by analogy with the becoming topological of computation (as observed by Reed, Cavia or Pasquinelli) or culture (see Lury/Parisi/Terranova 2012). Such a constructive approach also carries the Kantian legacy further by reworking it: Kant's model of orientation in thinking was also constructive in how it posited thinking to be orientable according to a principle of rational faith, set out as an imperative. In the case of topological thinking, an alternative imperative can be found in reason's scope for excess – excess both of itself and of the continuous nature of reality it models (Plotnitsky 2012: 367–368). That contrasts with the docile vibe of Kant's model of orientation. Furthermore, the constructive project under discussion here aligns with an ambition of synthetic mathematics to maintain a pendular movement between integrative and differentiating acts of thought.

A hint toward such a constructive project that operationalizes the topological model of reasoning endemic to AI has been put forward by thinkers such as the aforementioned Yuk Hui or Ramon Amaro. The latter claims in this respect:

> what I'm thinking through, especially in terms of machine learning and artificial intelligence, is the potential for resistance within the spaces in between. That's why I was saying […] that this type of revolution, for me, ultimately comes down to revolution of us with ourselves, and actually how we consider our own self-actualisation in accord with these technologies. (Amaro/Hui/Dasgupta 2021: 55)

Beyond abolishing AI technologies as means of archaically cataloging different "genres of being human" (Wynter/McKittrick 2015: 31–32) lies the task of understanding how these genres get actualized – and even multiplied – in confrontation with such technologies. In this pursuit, unlocking the topological aspects of ANNs' computational logic and showing that they are more than their historical context is both possible and politically salient. As Ramon Amaro sums up:

> there's a computational logic that cannot be comprehended by humans, and I see a great potential in that, in terms of race, in terms of gender dynamics, in terms of homophobia and so on and so forth. (Amaro/ Hui/ Dasgupta 2021: 55)

Again, an imaginary interlocutor may ask: How is it possible for a computational logic to engage at all with such socio-historically bounded phenomena such as race or gender dynamics? The answer lies again in an analogy with Yuk Hui's cosmotechnics: the topological model of reason delivered by ANNs functions as a generic space – a more generous image (compared with the geographical model of orientation) from which genres of thinking can be born, and where they can mutate as well as undergo massive processes of reconstruction. Replacing the underlying interpretive framework of thought can cause a cascade of spontaneous reverse-engineering operations that reshuffle the foundational assumptions of any system, thus restructuring the system from within. The effects of such restructuring could reverberate into every corner of the system, including those that interface with (and spill into) social, political and economic reality.

6. Conclusion

The picture of AI that this chapter presents is the one of a dual mirror. Evidently, AI can be appropriated by subsumptive logic of instrumental, enumerative rationality. But that is just one part of the story. Its second function is that of a mirror which generates what Reza Negarestani has labeled an "outside view of ourselves":

> whereby AGI or computers tell us what we are in virtue of what we are determinately not – i.e., contra negative theology or the uncritical and merely experiential impressions of ourselves. This objective picture or photographic negative may be far removed from our entrenched and subjectivist experience of ourselves as humans. (Negarestani 2018: 4)

This outside view involves an image of reason that assumes a degree of plasticity over what reason is, and it advertises a constructivist approach to delimiting its gestures, tools and competences. The proposition then is that the topological model of thinking latent in the computational architecture of ANNs represents an applicable, insightful and normatively interesting model for the construction of reason; a model which would orient itself according to principles that transcend the most at-hand critiques of the use of AI in the current socio-historical context, still trapped in an "entrenched and subjectivist experience of ourselves as humans" (Negarestani 2018: 4). The emergent alternative topological model of reason we have discussed above runs parallel to these critiques, exploding the stability of anthropomorphic hierarchies, subsumptions and stiff categorial matrices (which is in the end also an ambition of the critiques of AI). Instead of giving all the credit to the grounds of thinking-as-we-know-it, the topological model of reason drawn from ANNs is historically extraneous, bringing an element of a productive determination from the outside that can contribute to reconstructing what it means for thinking to think.

Ultimately, this emerging image of reason should be seen as part of a longer history of modeling thinking and rationality on different operations in the world. Kant broke important ground in his orientation essay, but his was also a limited excavation because it developed its concept from geographical orientation, fundamentally binding reason to an anthropomorphic need. Although there is nothing intrinsically wrong with drawing from empirical models, the model's primacy contributed to a hegemonic idea about how reason ought to act, making it comfortably human in the process. The outside perspective we are starting to see – given, for example, by the computational logic of AI we have considered in this chapter – is interesting not because it constitutes an alien way of "thinking" but because it frees us to construct new grounding narratives about what reason ought to do beyond any familiar standards. The model gives us leverage on saying what it can conceivably mean to orient oneself in thinking by replacing an archaic concept of orientation that urged us to privilege familiarity. It is on this road that we can begin to dissociate rationality from its human context so as to take a step toward thinking about loftier standards of what thinking can mean, and to see whether the self-transformation of thinking can also transform its milieu.

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