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Lorenzo Magnani

Eco-Cognitive Computationalism

Cognitive Domestication of Ignorant Entities

Springer

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If we are trying to produce an intelligent machine, and are following the human model as closely as we can, we should begin with a machine with very little capacity to carry out elaborate operations or to react in a disciplined manner to orders (taking the form of interference). Then by applying appropriate interference, mimicking education, we should hope to modify the machine until it could be relied on to produce definite reactions to certain commands. This would be the beginning of the process.

Alan Turing, Intelligent Machinery, 1948

To my cat Sheena

Preface

The book addresses a new approach to computation I call "eco-cognitive", which stresses the attention to the question of the overwhelming domestication of ignorant entities, which is at work in our current societies. I think the intellectual and didactic virtues of this approach resort to the conviction that seeing at computation in the special interdisciplinary perspective I am proposing avoids reducing the analysis of computation to a rigid one-sided view, privileging the theoretical commitment towards the study of computation as a variegated phenomenon that regards human beings in their individual and social lives.

The book aims at stressing that an open-minded analysis of computation must take into account:

- the *distributed* and *embodied* nature of computational tools, models, and methods, ultimately related to the idea of the current importance of the external cognitive machines as mediators of cognition;
- the central role of the dynamics of the production—and of the rational handling—of new kinds of unconventional computations, by referring to the various *multimodal* related epistemological aspects;
- the fact that computation can be satisfactorily examined only in an *eco-cognitive* perspective.

These topics are analyzed in terms of what I consider the main tenets of an eco-cognitive approach computation:

1. Chapter 1 The concepts of information, computation, and cognition are variously interpreted and explained and still lead to ambiguous results. I contend that seeing the evolutionary emergence in humans of information, meaning, and of the first kinds of cognition as the outcome of dynamic coevolutionary interactions between brain/mind internal processes, body itself, and external environment can be extremely useful (1) to clarify the most common misunderstandings and the basic vagueness of the concepts above and (2) to appropriately describe "computation" as an evolving concept subjected to continuous transformations of meaning. To this aim, I also take advantage of the dynamic concepts

of salience and pregnance derived from Thom's catastrophe theory. When the physical computation is seen in the perspective of the ecology of cognition, it is easy to understand Turing's original ideas concerning the emergence of information, cognition, and computation in organic, inorganic, and artefactual agents, which I also briefly illustrate in this chapter. I also show that seeing computation as dynamically active in distributed physical entities of various kinds suitably transformed so that data can be encoded and decoded to obtain appropriate results further sheds light on what I call *eco-cognitive computationalism*. I hope it will become clear that eco-cognitive computationalism does not aim at furnishing an ultimate and static definition of the concepts of information, cognition, and computation, such as a textbook could provide, instead, it intends, by respecting their historical and dynamical character, to propose an intellectual framework that depicts how we can understand their forms of "emergence" and the modification of their meanings.

2. Chapter 2. Eco-cognitive computationalism sees computation in context, exploiting the ideas developed in those projects that have originated the recent views on embodied, situated, and distributed cognition. As illustrated in the previous chapter, Turing's original intellectual perspective has already clearly depicted the evolutionary emergence in humans of information, meaning, and of the first rudimentary forms of cognition, as the result of a complex interplay and simultaneous coevolution, in time, of the states of brain/mind, body, and external environment. This cognitive process played a fundamental heuristic role in Turing's invention of the universal logical computing machine. It is by extending this eco-cognitive perspective that we can see that the recent emphasis on the simplification of cognitive and motor tasks generated in organic agents by *morphological aspects* implies the construction of appropriate *mimetic bodies*, able to render the accompanied computation simpler, according to a general appeal to the "simplexity" of animal embodied cognition. I hope it will become clear that, as already contended in the previous chapter, eco-cognitive computationalism does not aim at furnishing a final and fixed definition of the concept of computation, but stresses the historical and dynamical character of the concept.
3. Chapter 3. *Locked* and *unlocked strategies* are at the center of this chapter, as ways of shedding new light on the cognitive aspects of deep learning machines. The character and the role of these cognitive strategies, which are occurring both in humans and in computational machines, are indeed strictly related to the generation of cognitive outputs, which range from weak to strong levels of knowledge creativity. For a better understanding of the computational aspect, I will also illustrate the abductive character of the concept of *anticipation* in human cognition linking it to the cognitive problem of spatiality and of the genesis of space in the description of the abductive role of the *Abschattungen* (adumbrations), as they are described in the framework of the philosophical tradition of phenomenology. Anticipations share various features with visual and manipulative abduction and prove it to be a useful tool to favor the characterization of the two kinds of strategic reasoning I am introducing in this chapter. It will become clear that the differences between strong and weak

levels of creativity lead to important consequences when we analyze computational AI programs, such as AlphaGo/AlphaZero, which aim at performing various kinds of abductive hypothetical reasoning. In these cases, the programs are characterized by *locked* abductive strategies: they deal with weak (even if sometimes amazing) kinds of hypothetical creative reasoning, because they are limited in what I call *eco-cognitive openness*, which instead qualifies human cognizers who are performing higher kinds of abductive creative reasoning, where cognitive strategies are instead *unlocked*.

4. Chapter 4. In the first two chapters of this book, we have stressed that eco-cognitive computationalism sees computation in context, following some of the main tenets advanced by the recent cognitive science views on embodied, situated, and distributed cognition. We have also described the new attention in computer science devoted to the relevance in the computation of the morphological features. It is by further deepening and analyzing the perspective opened by these novel fascinating approach that we see ignorant bodies as *domesticated* to become useful "mimetic bodies" from a computational point of view. This new perspective shows how the computational domestication of ignorant entities can originate new variegated unconventional cognitive embodiments, so opening the new research field of the so-called *natural computing*. In the last part of the chapter, I will introduce the concept of overcomputationalism, showing that my proposed framework helps us to see the related concepts of pancognitivism, paninformationalism, and pancomputationalism in a more naturalized and prudent perspective, avoiding the excess of old-fashioned ontological or metaphysical overstatements. Finally, I will submit to the attention of the reader a question that in my opinion synthesizes all the problems described in the chapter: will the future of eco-cognitive settings be computationally tailored or humanly tailored?

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Contents