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1 Introduction

Lorenzo Magnani has long explored abductive reasoning and the ecology of cognition, most notably in *Abductive Cognition* (2009) and *The Abductive Structure of Scientific Creativity* (2017). Across these works, he developed the view that human reasoning is an evolving, eco-cognitive process in which knowledge emerges through interaction between minds, artefacts, and environments.

Eco-Cognitive Computationalism continues this trajectory by bringing computation into the same cultural and epistemological frame. In this book, Magnani presents computation as a human cognitive activity, and an ongoing process of cultivating “ignorant entities” into cognitive mediators through processes of abduction, representation, and material engagement. The “eco” in this framework refers to historical and cultural ecologies of meaning: the social, technological, and symbolic environments in which human reasoning unfolds. Within these evolving settings, computation appears as a human technique of world-making, growing through the continuous domestication of matter, language, and code.

The book resonates with the principles of Digital Humanism (Werthner et al. 2022), which seek to reorient digital technologies toward human and cultural values. The following review outlines Magnani’s main ideas and highlights how his concept of domestication of ignorant entities offers a timely vocabulary for understanding the human inclusion of artificial intelligence in contemporary culture.

2 Summary

The first chapter introduces a framework for tracing meaning shifts within evolving contexts. Magnani follows the historical co-development of information, cognition, and environment, beginning with Turing’s (1948) notion of “unorganised machines” and Thom’s (1983) reflections on the dynamics of form. Information emerges as a structured difference within an interpretive field, and cognition as the human domestication of such differences into usable representations. Computation unfolds as the historical process through which humans organise ignorance into intelligibility, transforming the material and symbolic world into supports for reasoning.

The second chapter turns to the embodied dimension of computation. Drawing on Hutchins’ (1995) distributed cognition and Clark’s (2016) extended mind, Magnani presents eco-cognitive computationalism as a relational process in which cognition extends into material form. His discussion of morphological computation draws on examples from soft robotics and embodied AI, where the physical form of a system contributes to cognitive performance. Morphological computation here refers to engineered artefacts whose material and structural properties become partners in thinking, showing how human design integrates intelligence into morphology and purpose.

The third chapter centres on abduction as the generative logic of human reasoning. Magnani distinguishes locked strategies, which operate within finite and rule-bound domains such as the game of Go, from unlocked strategies, which guide open, multimodal, and historically situated reasoning in natural and social environments. His discussion of AlphaGo illustrates how contemporary AI systems explore vast search spaces while remaining bound to the frames defined by their objectives. Abduction, in Magnani’s sense, characterises human cognition as a practice of openness and reinterpretation. Computation, when aligned with abductive reasoning, becomes a means of creating new cognitive relations between humans and their artefacts—a process through which meaning itself evolves.

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The fourth chapter concludes the book with an ethical reflection on the futures of computation. Magnani addresses the expansive reach of computational thinking and the risk of cognitive environments becoming overly optimised for machine efficiency. Protecting “ignorant entities” means preserving spaces of uncertainty and simplicity that sustain human abductive creativity. The balance between domestication and openness defines the ethical horizon of his framework: a world of computational tools that support, rather than replace, human interpretive freedom. The question remains: how can future technologies remain humanly tailored? This concern aligns with the principles of Digital Humanism (Werthner et al. 2022), where digital technologies are understood as elements of a shared human ecology requiring care, design, and responsibility. However, while Digital Humanism emphasizes normative reorientation of technology toward social values, Magnani provides a philosophical grounding for why cognition itself is inseparable from its material and cultural scaffolds—offering a deeper epistemological justification for human-centered design. Magnani’s perspective thus becomes a call for the re-culturalisation of computation—a restoration of technology to its place within human cognitive and ethical life.

3 Evaluation

Eco-Cognitive Computationalism presents a vision of computation that unfolds within human life and culture. Magnani conceives computation as a practice of human cognition mediated by tools, languages, and technologies. The strength of this framework lies in its human-centred orientation—the understanding that computing expresses the ways humans cultivate meaning and intelligence within their environments.

The concept of domestication gives this vision its distinctive force. To domesticate “ignorant entities” is to transform materials, symbols, and artefacts into co-agents of human cognition. This process traces a historical continuum between technological invention and cultural learning, revealing how computation participates in the broader evolution of human understanding.

Magnani’s integration of abduction within this framework provides particularly fertile ground. By situating abduction at the centre of human reasoning, he shows how creativity and interpretation sustain the continuity between thought and environment. His distinction between locked and unlocked strategies illuminates the dynamic tension between computational efficiency and cognitive openness. Intelligence appears as the capacity to reframe problems and to maintain interpretive flexibility—an ability that anchors the ethical dimension of human cognition. Recent generative models, such as large language

models, introduce forms of synthetic abduction, generating hypotheses and interpretations that participate in human abductive ecologies.

The discussion of morphological computation further illustrates this point. Examples from robotics show how the shape and material of artefacts can contribute to thinking processes, reminding us that human cognition extends through the forms and tools it creates. Computation appears here as part of a wider continuum of design, embodiment, and cultural practice.

Magnani’s framework differs from biologically centred approaches such as Maturana and Varela’s *life as cognition* (1980), Friston’s free-energy principle with active inference (2013) and the info-computational framework of Dodig-Crnkovic (2017). While those models describe all living systems as cognitive systems within biological environments, Magnani situates cognition within cultural and technological ecologies. His notion of cognitive domestication concerns how humans integrate tools, symbols, and artefacts into evolving practices of meaning-making. In this sense, eco-cognitive computationalism extends the study of cognition from biological adaptation to cultural mediation.

In its ethical dimension, the book invites reflection on the direction of cognitive evolution in an age of pervasive computation. As humans domesticate technological systems, they also reshape the horizons of their own cognition. Protecting “ignorant entities” becomes a metaphor for sustaining the spaces of uncertainty that nurture learning and creativity. The challenge is to guide this ongoing transformation toward human openness, ensuring that computational ecologies continue to respond to the diversity of human life. However, this focus on human-centred cognitive practices leaves open an important question regarding the broader biological grounding of cognition as studied in the mentioned naturalised cognitive approaches. Frameworks that begin cognition with life itself, not only with humans, emphasize cognition’s intrinsic emergence from living systems’ adaptive dynamics. Such perspectives carry profound ethical implications, as they recognize cognition as continuous with life’s processes, implicating non-human organisms and ecosystems within the moral sphere. Engaging critically with this tension invites future work to explore how Magnani’s approach might dialogue with or integrate naturalised cognition’s biological foundations, thereby enriching the conceptual and ethical horizons of cognitive theory.

Magnani’s Eco-Cognitive Computationalism contributes a vocabulary for understanding computation as part of human cultural evolution. It captures the continuing process through which humans integrate new artefacts and intelligences into the fabric of social and cognitive life. The framework invites reflection on the re-culturalisation of computation—the return of technology to the human contexts of meaning, interpretation, and care.

The book's key message is clear: computation, in this perspective, is one of the tools that human cognition domesticates to extend its reach. It reminds us that thinking, in all its technological forms, remains a practice of mediation through which human culture continually reinvents itself.

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Declarations

Conflict of interest The authors declare no competing interests.

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References

- Clark A (2016) *Surfing uncertainty: prediction, action, and the embodied mind*. Oxford University Press, Oxford. <https://doi.org/10.1093/acprof:oso/9780190217013.001.0001>
- Dodig-Crnkovic G (2017) Nature as a network of morphological info-computational processes for cognitive agents. *Eur Phys J Spec Top* 226(1):181–195. <https://doi.org/10.1140/epjst/e2016-60362-9>
- Friston K (2013) Life as we know it. *J R Soc Interface* 10(86):20130475. <https://doi.org/10.1098/rsif.2013.0475>
- Hutchins E (1995) *Cognition in the wild*. MIT Press, Cambridge
- Magnani L (2009) *Abductive cognition: the epistemological and eco-cognitive dimensions of hypothetical reasoning*. Springer, Berlin. <https://doi.org/10.1007/978-3-642-03631-6>
- Magnani L (2017) *The abductive structure of scientific creativity*. Springer, Berlin. <https://doi.org/10.1007/978-3-319-59256-5>
- Maturana HR, Varela FJ (1980) *Autopoiesis and cognition: the realization of the living*. D. Reidel Publishing Company, Dordrecht
- Thom R (1983) *Mathematical models of morphogenesis* (Wiley, New York, 1983)
- Turing A (1948) *Intelligent machinery*. In: Copeland BJ (ed) *The essential turing* (Oxford, 2004; online edn, Oxford Academic, 12 Nov. 2020), <https://doi.org/10.1093/oso/9780198250791.003.0016>
- Werthner H, Prem E, Lee EA, Ghezzi C (eds) (2022) *Perspectives on digital humanism*. Springer, Berlin. <https://doi.org/10.1007/978-3-030-86144-5>

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