Book Review

# Philosophy of Computing and Information - 5 Questions,
## Edited by Luciano Floridi

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**CONTRIBUTORS:** Margaret A. Boden / Valentino Braitenberg / Brian Cantwell-Smith / Gregory Chaitin / Daniel C. Dennett / Keith Devlin / Fred Dretske / Hubert L. Dreyfus / Luciano Floridi / Tony Hoare / John McCarthy / John R. Searle / Aaron Sloman / Patrick Suppes / Johan van Benthem / Terry Winograd / Stephen Wolfram

*"Computing and information, and their philosophy in the broad sense, play a most important scientific, technological and conceptual role in our world. This book collects together, for the first time, the views and experiences of some of the visionary pioneers and most influential thinkers in such a fundamental area of our intellectual development. " (Floridi)*

This book is one among pearls in the 5 Questions Series by Automatic Press / VIP which presents answers on 5 challenging questions by number of the leading modern thinkers, in this case within the Philosophy of Computing and Information.

The questions the editor, Luciano Floridi asked are the following:

*1. Why were you initially drawn to computational and/or informational issues?*

*2. What example(s) from your work (or the work of others) best illustrate(s) the fruitful use of a computational and/or informational approach for foundational researches and/or applications?*

*3. What is the proper role of computer science and/or information science in relation to other disciplines?*

*4. What do you consider the most neglected topics and/or contributions in late 20th century studies of computation and/or information?*

*5. What are the most important open problems concerning computation and/or information and what are the prospects for progress?*

Given the public interest in the eminent contributors, the answers to the question about how they got interested in the field of Computing and Information is both instructive and historically significant. They are highly personal and vivid reminiscences of the pioneering times and therefore hard to recapture in this review - they just have to be read the way they are told.

For the rest of the answers, I will give a short account for each of the contributors, often using their own words as illustration.

As the editor points out in the introduction, the contributors had the freedom to interpret the questions and answer in the format they find suitable, which resulted in a very different individual styles of responses, which also adds to the charm of the book.

**Margaret Boden** gives us a detailed account about "how computational ideas can clarify fundamental – philosophical and psychological – questions about the nature of mind" with number of valuable pointers and references. Boden declares: "My own view is that a naturalistic view must be possible, and that it is likely to be grounded in evolution". Boden is rightly warning against "regrettable hostility" between different approaches in Cognitive Science (symbolic, connectionist, situated, dynamical, and homeostatic ) – "because all of them (and probably more) will be needed to emulate the rich space of possible minds".

**Valentino Braitenberg** emphasizes the importance of complexity, "not only in the brain but generally in living matter everywhere" and the ability of information which "properly understood, is fully sufficient to do away with popular dualistic schemes invoking spiritual substances distinct from anything in physics ".

**Brian Cantwell-Smith** illustrates his own long journey in study of construals of computing to conclude that "in one way or other, computation involves an interaction or interplay of *meaning* and *mechanism*." When it comes to meaning (semantics) Smith is not so much interested in the relation between a program and a process which results from running it, but rather on the connection between that process and the task domain that the process is about, in other

words, he is “interested in the semantics of the semantics of programs”. Finally, Smith claims that ontology and epistemology must be reconstructed together, as a new metaphysics: “as we can now see a comprehensive theory of meaning/mechanism dialectic – involves nothing less than a full-fledged assault on constructing an appropriate metaphysics”. For Smith, computers can help by serving as “laboratories of middling complexity” “in terms of which to explore issues of intentionality, embodiment, and semantics.”

**Gregory Chaitin** relates information with his algorithmic complexity, Leibniz’s argument about the necessity for natural laws to be simple and knowledge as information compression. An important contribution to the field is his epistemology as information theory. “A scientific theory is only of value to the extent that it’s a compression.” and “Understanding is compression of information”. Recently he is applying his ideas about complexity to biology.

**Daniel C. Dennett** gives examples from his work, especially his essay “Artificial Intelligence as Philosophy and Psychology” (1978) as illustration of a possibility of demonstrating simplified working models of cognitive process. “Computer science keeps cognitive science honest”. As the unsolved problem Dennett selects the lack of solid theory of semantic information.

**Keith Devlin** makes distinction between information as a semantic concept and its syntactic representation. His approach is based on Barwise and Perry’s situation theory. This of course has a very relevant social domain in which “the goal is not “perfect understanding” but better (i.e. deeper, more precise, more illuminating, more useful) understanding.” Devlin continues by concluding that “ we learned more about language by seeing the extent to which real language both conforms and differs from Chomsky’s mathematical descriptions”.

**Fred Dretske** starts his research with epistemology, and is of interest as a building block of knowledge. As knowledge by definition always is true, so must its constituent parts in this view also be true. Dretske adds however: “If, as I (once again) suspect, contributors to this volume mean something else by term “information” then our answers to the questions posed will not only be different, they will be different *because* – and, perhaps, *only* because – they are understood to be answers to quite different questions.” “The disagreements – and there are sure to be many – might not run very deep once the merely verbal differences are sorted out.”

**Hubert L. Dreyfus** was in 1963 invited to evaluate Alan Newell and Herbert Simon's work on Cognitive Simulation. As a philosopher, he readily recognized that AI scientists were in practice turning rationalist philosophy [Hobbes, Descartes, Leibniz, Kant, Russell] into a research program of GOFAI. An intelligent (expert) system with a set of true statements and logics was used to assess the facts of the real world. Dreyfus' conclusion was that "the deep problem wasn't storing millions of facts; it was *knowing which facts were relevant* in any given situation". In the alternative, "Heideggerian/Merleau-Pontian approach to AI suggested by Freeman, which would solve the problem of relevance and was ontologically sound in a way GOFAI was not, "a neurodynamic computer model would have to be given a detailed description of a body and motivations as ours if things were to count as significant for it so that it could learn to act intelligently in *our* world."

**Luciano Floridi** describes his search for "epistemology without knowing object" and methodological minimalism obtained in epistemology by step of adopting a more fundamental level of abstraction – information instead of traditional knowledge. Floridi characterizes computer and information sciences as "epistemic enablers". He claims that Philosophy of Information is becoming our *Philosophia Prima*, also "because computational and informational ideas and artifacts are today so essential for our scientific development".

"One of the most neglected topics in late twentieth century studies of computation and information is a *philosophy of nature in the widest sense of the word* (that is in the German sense of *Naturphilosophie* as this was used by Schelling and Hegel)." – we can only agree.

**Tony Hoare** directs his account on the history and the future of the effort of making software error-free. He ends with the following optimist vision: "let me look forward to the day when programming error is a problem from the past; when computer programmers make fewer mistakes than engineers in any other profession" – we all look forward to that day. In this context it would be interesting and highly relevant to learn more about Hoares study of Process Algebra – a mathematical formalism developed to describe systems in continuous interaction with the environment – increasingly important in new paradigms of computing.

**John McCarthy** advises that “Philosophers need to adopt some of the practices of AI and first study simple variants of phenomena like action, knowledge, belief and context rather than only looking for the most general definitions.” – which is a view he shares with many among other book contributors.

**John R. Searle** concludes that “The most neglected topics in studies of computation and information that are psychologically real, that is, that are relevant to Cognitive Science, have to do with the question of how the brain actually works as a physical biological system.” Searle insightfully welcomes the move from computational Cognitive Science to Cognitive Neuroscience.

**Aaron Sloman** represents the *design stance* (ie “learning how to produce explanations of working systems (e.g. minds), in particular explanations that are capable of being tested in working implementations” by constructing machines with cognitive capacities. His conclusion is that *informational architecture* is central for understanding of cognition: “I begun to think about integrated information-processing architectures combining many different sorts of components, and that eventually led me to the design-based analysis of many other aspects of human minds and animal minds, constantly driven by the question: what sort of machine could do *that*?” For the future “Understanding the variety of types of virtual machines and the variety of ways in which virtual machines can be implemented or realized in physical machines or other virtual machines, will, I suspect, provide much matter for philosophical analysis in future years.”

**Patrick Suppes** points out that brain computations on a system level are electromagnetic while on the cell level they are chemical. They are probabilistic and deeply parallel in structure. When it comes to the question of continuum vs. discrete character of computational mechanism, Suppes interestingly refers to Kant’s Second Antinomy, theory that the whole consists of indivisible atoms whereas, in fact, none such exist; while in question of the relationship between free will and causally bound mechanism, he refers to the Kant’s Third Antinomy addressing the problem of freedom in relation to universal causality. As a most important open problem Suppes chooses “the fundamental nature of space and time” with an interesting remark: “But there is still a reluctance to develop what seems to be a natural isomorphism between discrete space-time and continuous space-time.” One of the open questions is for Systems Neuroscience: how large

collections of synchronized neurons are computing, with all relevant physics and chemistry.

**Johan van Benthem** describes John Barwise and John Perry's "situation semantics" as "a radical alternative to the ancient regime in philosophical and mathematical logic. On their view (..) logic should study the information available in rich distributed environments (with both physical and human components), and the resulting information flow." "Statics and dynamics come together in modern logics of what may be called *intelligent interaction* – and this is no coincidence. Logic and information should take the systematic Tandem View that information can not be understood in isolation from the process which conveys and transforms it. *No information without transformation!"*[i] van Benthem also rightly notices cohesive force that concept of information presents: "interest in information and computation as themes cutting through old boundaries between the humanities, social, and natural sciences". He also emphasizes the interplay between statics and dynamics, information and process.[ii]

Computer Science or rather Informatics in this context provides tools for representation of data together with methods of computation over them. Unlike Turing Machines which are sequential computational models, more general formulations provide explicit representations of concurrency and communication such as the process algebra among others.

Van Benthem concludes: "Taking biological and psychological facts seriously is not uncontroversial in logical circles, but "Information, Computation and Cognition" may be the way to go.

**Terry Winograd** describes his own fundamental work as "critical re-examination of the relationship between symbolic processing and the communicative workings of ordinary human language." Winograd characterizes computer science as a mix of disciplines unlike classical sciences but with new and promising possibilities, both as models and tools opening "a new world of examples and Gedanken experiments. "we can see 21$^{st}$ century ascendance of the biological sciences as a product of being able to deal with extreme complexity in a rigorous computational way." As the largest open problem Winograd mentions "the relationship between computation, of the kind we understand from digital computers, and the informational activities of the human brain/mind." "The "decoding of thought" is a far-off but intriguing goal." – Winograd finishes.

**Stephen Wolfram** spent some twenty five years applying computational ideas to fundamental science. “The single most fruitful concept has been exploring the computational universe of possible programs.”

He explains: “Learning about computational universe also informs many old foundational questions in science and elsewhere. It shows us, at a basic level, why complexity is so easy for nature to produce, and so widespread. It shows us that there are fundamental computational limitations to traditional mathematical science. It gives us insight into how similar phenomena like intelligence are to natural processes. It shows us how special – and in many ways arbitrary – the formal systems like mathematics that we have built are.”

Finally Wolfram concludes: “Of one thing I am certain: in the computational universe there is a huge amount that we can mine for human purposes – for creating technology, or art or other things that we as humans use.”

The above account gives just a few glimpses from this book abundant in new ideas and insights. In sum: this is a highly recommendable and really enjoyable reading.

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[i] Compare to ”*No information without computation*” as found in the introduction to: Dodig-Crnkovic G. and Stuart S., eds. Computation, Information, Cognition – The Nexus and The Liminal, Cambridge Scholars Publishing, Cambridge 2007

[ii] In my research in the field I came to the same conclusions. See Gordana Dodig-Crnkovic *Investigations into Information Semantics and Ethics of Computing* *http://www.diva-portal.org/mdh/theses/abstract.xsql?dbid=153*, Mälardalen University Press, September 2006