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Is computationalism trivial?

[Abstract: 291 words]
In this paper, I want to deal with the triviality threat to computationalism. On one hand, the controversial and vague claim that cognition involves computation is still denied. On the other, contemporary physicists and philosophers alike claim that all physical processes are indeed computational or algorithmic. This claim would justify the computationalism claim by making it utterly trivial. I will show that even if these two claims were true, computationalism would not have to be trivial.
First, I analyze the vague definition of computationalism. By showing how it depends on what we mean by 'a computational process', I distinguish two main flavors of computationalism claim:

1. That cognitive processes could be described algorithmically (in G. Chaitin's sense of 'algorithmic')
2. That cognitive processes are algorithmic or computational (they implement recursive functions).

This second claim could be analyzed further as a claim:

1. That cognitive processes could be described as computational
2. That cognitive processes are really implemented computationally
3. That cognitive processes are generated by computational processes.

I distinguish then three varieties of computationalism. The first is that cognitive processes can be simulated computationally; the second is that they can be realized computationally; the third is that cognitive processes are generated by overall computational processes. This last sense is on the verge of being trivial if we accept that all physical processes are computational. I show that the non-trivial computationalism involves a multi-level model of cognition where certain level of organization of processes is emergent on the base level. This base level could be even conceived of as algorithmic but the emergent computational level would implement other algorithms than the base level. I try to sketch a multi-level model of cognition which involves computation without being at the same time trivial.

Is computationalism trivial?

[Abstract: 913 words]
In this paper, I want to deal with the triviality threat to computationalism. On one hand, the controversial and vague claim that cognition involves computation is still denied (e.g. in the recent embodied cognition theory). On the other, contemporary physicists and philosophers alike claim that all physical processes are indeed computational or algorithmic (S. Wolfram, E. Fredkin, S. Lloyd, Y. Jack Yng, and in the context of evolutionary theory D. Dennett). This claim would justify the computationalism claim by making it utterly trivial. I will show that even if these two claims were true, computationalism would not have to be trivial. I'm not arguing for nor against these claims as such arguments would require a more detailed analysis of the concepts in question; however, these claims cannot be simply discarded as necessary false or unimportant. The result of the analysis is taxonomy of possible computationalisms.
First, I analyze the broad and vague definition of computationalism as a claim that cognitive processes involve computational processes. It depends on what we mean by 'a computational process', or 'algorithmic process'. I distinguish two main flavors of the computationalism claim:

1. That cognitive processes could be described algorithmically (in G. Chaitin's sense of 'algorithmic'), i.e. they expose non-stochastic regularity which could be accounted for in some compression algorithm;
2. That cognitive processes are algorithmic or computational, i.e. they implement recursive functions or realize computations.

The first flavor of computationalism is only a very weak claim that the cognitive processes could be accounted for in some scientific theory including laws (not necessarily physical-mental laws denied by D. Davidson in his anomalous monism). In what follows, I will focus on a second claim, which seems more controversial. This second claim could be analyzed further as a claim:

1. That cognitive processes could be described as computational
2. That cognitive processes are really implemented computationally
3. That cognitive processes are generated by computational processes.

These three versions are derived from three possible senses of what an algorithmic process is: (1) it is a process described in terms of recursive functions (descriptive algorithmic); (2) it is a process implemented by recursive functions (realization-algorithmic); (3) it is process caused by a process (2) in some physical device (derivative-algorithmic).
Next, I distinguish three varieties of the second flavor of computationalism. The first is that cognitive processes can be simulated computationally. This is the variety that involves the popular 'computer-metaphor' talk.
The second claim is that cognitive processes are realized computationally. This is a classical sense of computationalism in CS. Realization of algorithms can be defined in terms of discrete states of physical causal processes: An algorithm A is realized iff there is an descriptive algorithmic sequence A' (a sequence having a description in terms of recursive functions) encoded in a physical medium that in connection with a physical device D causes some derivative algorithmic processes A" which in turn generate descriptive algorithmic sequences A'".
The third variety is that cognitive processes are generated by universal computational processes. This last sense is on the verge of being trivial if we accept that all physical processes are computational. But as I argue, this is not the case for certain models of cognition.
I show that the non-trivial computationalism involves a multi-level model of cognition where certain level of organization of processes is emergent on the base level. This base level could be even conceived of as algorithmic but the emergent computational level would implement

other algorithms than the base level. I try to sketch a multi-level model of cognition which involves computation without being at the same time trivial. In this model, not all processes, nor all computational processes, could count as cognitive processes. It seems plausible that a multi-level model of a cognitive system should comprise at least the following levels:

- Physical and chemical (including quantum level)
- Neurobiological
- Computational
- Representational
- Environmental/Adaptive
- Experiential/Conscious.

In the above model cognition involves computation, but even when all physical processes are digital and computational, the emergent higher levels of organization are not completely explainable in purely physical terms. In other words, they seem to implement other algorithms than the base physical level. The computational level which would involve, as in traditional cognitive science, information-processing of perceptual data, memory retrieval etc., but its computations would be implemented by a lower level processes or computations. In this sense, it is not trivial that there is any computational level in cognitive systems.

In summary, I enumerate possible versions of computationalism and point at these, which seem free from the triviality threat:

- weak regularity computationalism: cognitive processes can be described as non-stochastic;
- weak simulation computationalism: cognitive processes can be simulated as recursive functions;
- weak implementation computationalism: cognitive processes can be implemented as recursive functions;
- strong simulation computationalism: cognitive processes are actually simulated (e.g. in animals) as recursive functions;
- strong implementation computationalism: cognitive processes are actually implemented as recursive functions;
- weak multi-level computationalism: cognitive processes could be described as recursive function on some level of organization of cognitive systems;
- strong multi-level computationalism: cognitive processes are implemented by recursive function on some level of organization of cognitive systems;

However, only the strong multi-level computationalism is non-trivial if the claim that all physical processes are algorithmical/computational. The question arises whether this computationalism claim is empirical, metaphysical (conceptual) or simply heuristic for cognitive scientists. I will try to address this question shortly, by underlining the fact that it cannot be a pure conceptual claim.