Less is More: Minimal Intelligence in the History of Cognitive Science

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Abstract:

In this article, we give a novel interpretation of minimal intelligence, namely, the bottom-up intelligence.   By tracing a few interdisciplinary intellectual roots, we argue that intelligence is mainly an emergent phenomenon.   This assertion indicates that the fundamental principle of intelligence engineering is to generate intelligence bottom-up, and agent-based modeling provides us a powerful vehicle for reifying this idea.   By this principle, the intelligence that can be mechanized are mostly in a form of minimalism.   In this vein, minimal intelligence is the only kind of intelligence that we need to know and we can possibly harness.   The development of our arguments proceeds in a few phases.   We begin with the debate between neuronism and reticularism and its final settlement to the individuality of neurons. In our second phase, we proceed to the very beginning of the agent-based modeling of neurons, namely, the McCulloch-Pitts neural nets, the former body of Boolean networks as to be the earliest agent-based models.   This is the place that we see how minimal intelligence is literally applied to the elementary units, namely, the propositional neurons, which, as a whole, is equivalent to the logic reasoning that can be achieved as far as *Principia Mathematica* (Whitehead and Russell, 1925, 1927) can reach.   While "Social" interactions are not the concern of the McCulloch-Pitts nets, later work under the cloth of the Mill-Helmholtz-Hebb-Hayek tradition made that happen.   Specifically, Donald Hebb's assemblies of cells demonstrates networking of minimal-intelligent agents to be the first step toward emergent intelligence.   At this phase, connections are shown to play an indispensable role for emergent intelligence, and the intelligence required at the elementary level, known as Hebb learning, is manifested in the form of association learning, which was inherited from the study on animal intelligence by behavioristic psychologists

(Thorndike, 1911).   In the last phase, we move to the modern connectionism (Minsky and Papert, 1988) and modern behaviorism (Staddon, 2014) to address the historical contrast between connectionism and symbolism and to argue why less is more, as a virtue of minimal intelligence.