

Autopoiesis and Enaction in the Game of Life

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Over 40 years ago, the Chilean biologists Humberto Maturana and Francisco Varela put forward the notion of autopoiesis as a way to understand living systems and their phenomenology. Varela and others subsequently extended this framework to an enactive approach that places biological autonomy at the foundation of situated and embodied behavior and cognition. In this talk, I will describe an attempt to place these ideas on a firmer foundation by studying them within the context of a toy model universe, John Conway's Game of Life (GoL) cellular automata. The talk has both pedagogical and theoretical goals. Simple concrete models provide an excellent vehicle for introducing some of the core concepts of autopoiesis and enaction and explaining how these concepts fit together into a broader whole. In addition, a careful analysis of such toy models can hone our intuitions about these concepts, probe their strengths and weaknesses, and move the entire enterprise in the direction of a more mathematically rigorous theory. In particular, I will identify the primitive processes that can occur in GoL, show how these can be linked together into mutually-supporting networks, map the responses of such entities to environmental perturbations, and investigate the paths of mutual perturbation that these entities and their environments can undergo. Some of the topics that can be examined in GoL include the structure/organization distinction, organizational/operational closure, self-production, self-individuation, destructive vs. nondestructive perturbations, precariousness, cognitive domain, subjectivity, significance, sense-making, structural coupling, and enaction. I will end with some comments on the limitations of the GoL model and directions for future work.