Evolution in Prebiotic Systems: Cooperation In Utility-Based Agents

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Abstract— **Prebiotic evolution is one of the major challenges in complex systems theory. What differentiates the living from the nonliving is a perennial source of debate. It has been recently affirmed that discussions about if and how we can draw a line that separates life from non-life are useless. He motivates this using a "continuity thesis" (CT) argument i.e the existence of a continuum between inanimate and living state of matter. For other authors CT it is equivalent to say that there is no unbridgeable gap between inorganic matter and living systems, plus the corollary that the emergence of life is considered a highly probable event. This is related to the problem of how the minimal complexity required for a chemical system to start on the path of Darwinian evolution has been achieved. The CT from one side, and a trend towards an increasing complexity on the other, seems to require the existence of a constant driving force behind abiogenesis for two distinct reasons: a) to counterbalance destructive tendencies like hydrolysis in the evolving chemical structures and b) reduce the role played by chance to a minimum acceptable for a scientific discourse. In this work, I present a brief review of what has been considered the main driving forces behind prebiotic evolution i.e. self-organization of far-from-equilibrium open systems and (generalized) Darwinian evolutionary mechanism. I argue that, in order to explain the robustness and sustainability of complex systems not yet fully capable of Darwinian evolution a third element must be added: cooperation between molecular autonomous agents properly defined. In this work, I propose a general theoretical result to show how cooperation formation between a population molecular utility-based agents can give rise to self-sustaining networks.**

Index Terms—**Prebiotic evolution, entropy production, universal Darwinism, utility-based agents, Pareto equilibrium.**

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