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ONTOGENESIS AND PHYLOGENESIS OF DISCRETE DYNAMICAL SYSTEMS: DEVELOPMENTS IN CELLULAR AUTOMATA

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ABSTRACT

We consider the notions of ontogenesis and phylogenesis in the context of discrete dynamical systems. These notions were introduced for cellular automata in [1] where we studied different related notions such as recombination, assembly and mutation. In 2014 we developed the theory for iterated interval maps and recently in MATRIAD2015 we presented some of its features for general Markov discrete dynamical systems. A process is called ontogenetic if it refers to continuous changes observable on a single organism - development from a simpler to a complex form or state. An example is the embryonic development or morphogenesis. A process is called phylogenetic if there is a population which interacts with an environment, the individuals of the population interact between themselves and the change is noticed both in each individuals and in the characteristics of the population globally. In discrete dynamical systems, ontogenesis refers to the change process of a dynamical system, therefore, in a certain sense we can say we are considering a dynamical system where the state space is a set of discrete dynamical systems. In other words, we study changing dynamical systems. On the other hand, phylogenesis, refers to populations of discrete dynamical systems with certain common characteristics. Interactions between the individual dynamical systems must be considered, in particular a type of recombination process. Therefore, the global changes of the population characteristics can be analyzed. We present recent results regarding cellular automata, introducing the distinction between metabolic and regulatory processes.

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