On the learning dynamics of complex living systems

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In the framework of our study of Complex Systems we propose a systems approach to the theory of perception and learning in populations composed of many living entities. Starting from a phenomenological description of these processes, a mathematical structure is derived which is deemed to incorporate their complexity features. The modeling is based on a generalization of kinetic theory methods where interactions are described by theoretical tools of game theory. As an application, the proposed approach is used to model the learning processes that take place in a classroom. The aimof the paper is to provide a foundational mathematical framework which may incorporate the main features of the learning process in view of applications to modeling complex systems, including crowds, swarms, and social systems.cast into a differential framework. This paper, based on the aforementioned motivations and on some perspective ideas proposed in , pursues the objective of developing a mathematical theory of perception and learning in view of their application to modeling complex systems, which can develop a collective intelligence. We believe that our formulation can be viewed as an extension of the concept of population thinking and of the theory of evolution reported in. Indeed, this aspect will motivate us to relay on the tools of the evolutionary game theory. The mathematical tools are derived from the methods of the classical kinetic theory, statistical dynamics,stochastic evolutionary game theory and their development toward the theory of active particles . The latter was specifically developed to model living systems constituted of several multi-agents interacting by linear or nonlinear rules. Over the years this approach has been applied in a variety of different fields such as spread of epidemics , social systems , micro-scale Darwinian evolution and selection [23]and collective learning process. It is worth stressing that important motivations to the contents of this paper are induced by the idea that the mathematical structure might include features which could make it interesting in different field of life sciences.

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